FLYING BOATS

DOUBLEDAY

WAR PLANES OF THE SECOND WORLD WAR

FLYING BOATS

VOLUME FIVE

WILLIAM GREEN

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WAR PLANES OF THE SECOND WORLD WAR

by

William Green

Volume V

FLYING BOATS

During the Second World War, flying boats were largely restricted to the routine tasks of maritime reconnaissance and anti-submarine patrol. They have hitherto been neglected by aircraft historians. In this volume, the flying boats and amphibians of France, Germany, Great Britain, Italy, Japan, the Soviet Union and the United States of America are detailed, with many previously unpublished facts and photographs.

WAR PLANES FLYING BOATS 5

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With Drawings by Dennis I. Punnett

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INTRODUCTION

When the first shots of the Second World War were fired twenty-three years ago, the future of the military flying boat appeared assured. Large water-borne aircraft were considered to be indispensable by every major combatant, yet within a few short years the death knell of the flying boat as a first-line operational aircraft could be heard. In recent years only one major air power, the Soviet Union, has persisted with the development of large military flying boats, and, thus, the Second World War saw written what was destined to be virtually the last chapter in the long history of these aircraft.

Largely confined to the monotonous but vital tasks of long-range maritime reconnaissance, shipping protection, convoy escort and anti-submarine duties the routine nature of which tended to envelop the flying boat in an aura of anonymity, these slow and generally cumbersome machines have been seriously neglected by aviation historians in the post-war years, and little detailed reference is readily available concerning any but the best-known and most successful water-borne aircraft. Perhaps the lengthy vigils over the oceans of the world undertaken by the flying boat lacked something of the glamour and drama that accompanied the operations of land-based combat aircraft. Yet these machines participated in some of the most stirring sagas of the war years, and more than fifty distinctly different types of flying boat were used operationally by or were under development by the combatants between 1939 and 1945, including aircraft whose conception dated back to the 'twenties and a number of commercial machines hurriedly fitted with defensive and offensive armament during the opening stages of the conflict.

In this fifth volume of *War Planes of the Second World War* I have endeavoured to gather together all flying boats and amphibians employed for military tasks during the war years, and those, such as the Saro A.37, which played a part in military flying boat development. One aircraft, the Short Scion Senior FB, should, strictly speaking, be included in the sixth volume which is devoted to float seaplanes. I have decided to include it in this volume, however, as, although a floatplane, it was concerned solely with flying boat development.

The flying boats described and illustrated in the pages that follow vary tremendously in size, configuration and function, and much of the material contained in this volume has remained unpublished hitherto. The pattern of the volume follows that set by its predecessors, the flying boats of each of the combatants being dealt with in alphabetical order of manufacturers, and I should like to record my indebtedness to M. Akimoto, Richard Bueschel, Peter M. Bowers, Warren M. Bodie, Toshio Fukui, Pierre Leyvastre, Gert W. Heumann, Tullio Marcon, Eiichiro Sekigawa, Jacques Tiziou, Gordon S. Williams, the Historical Section of the French Navy, and the photographic department of the Imperial War Museum, all of whom have supplied information or photographs for inclusion in this volume.

London, May 1962 William Green

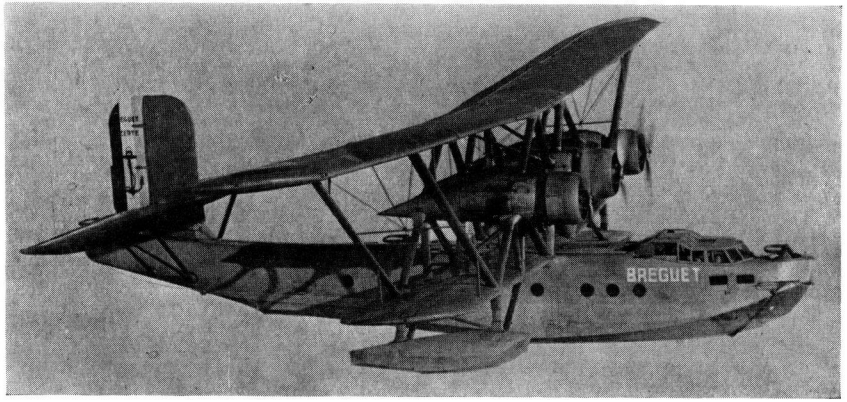
BREGUET 521 BIZERTE

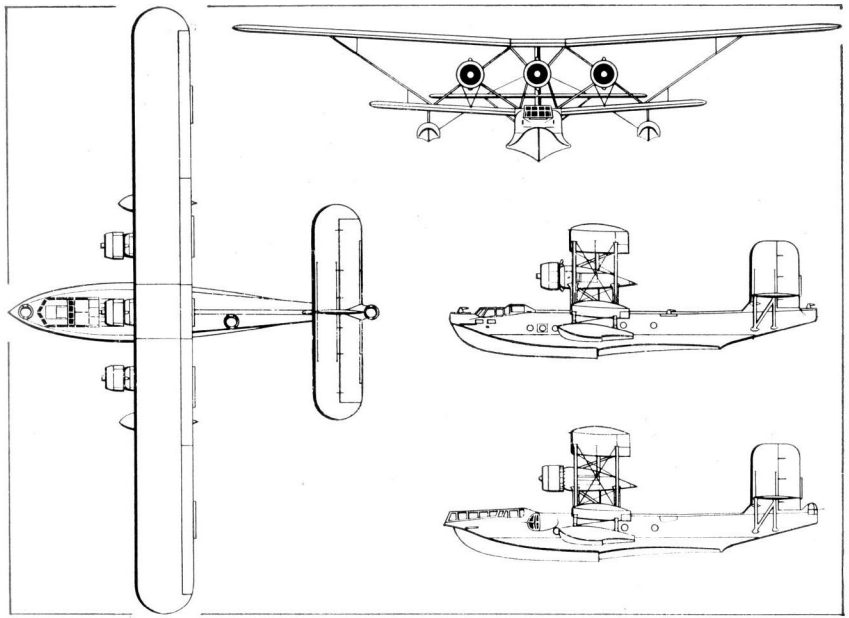
FRANCE

The Br.521 Bizerte long-range reconnaissance flying boat was evolved from the Calcutta, a manufacturing licence for which was acquired from Short Brothers by the Breguet company in 1931. The prototype, the Br.521-01, was built to meet the requirements of a French Navy specification for a long-range sea reconnaissance flying boat issued in 1932, and powered by three 825 h.p. Gnôme-Rhône 14 Kdrs radials, the aircraft flew for the first time at Le Havre on September 11, 1933. During initial trials, the uncowled engines were fitted with NACA cowlings, and in January 1934 official trials began at Saint Raphaël. These continued until mid-September 1934, and on April 1, 1935, the prototype was flown to Cherbourg for operational evaluation with Escadrille 1E2. An initial pre-production batch of three Bizerte flying boats had been ordered in the previous year, and the first of these completed its preliminary trials at Le Havre in October 1935, but the second production machine embodied several modifications, the principal of which were the elimination of the open bow gun position, the extension of the cockpit canopy, and the introduction of blister-type gun positions in the fuselage sides immediately aft of the flight deck.

The Bizerte was of all-metal construction, and all fuel was housed in the lower wing, the tanks having a total capacity of 1,155 Imp.

The initial pre-production Bizerte with the open bow gun position later eliminated.



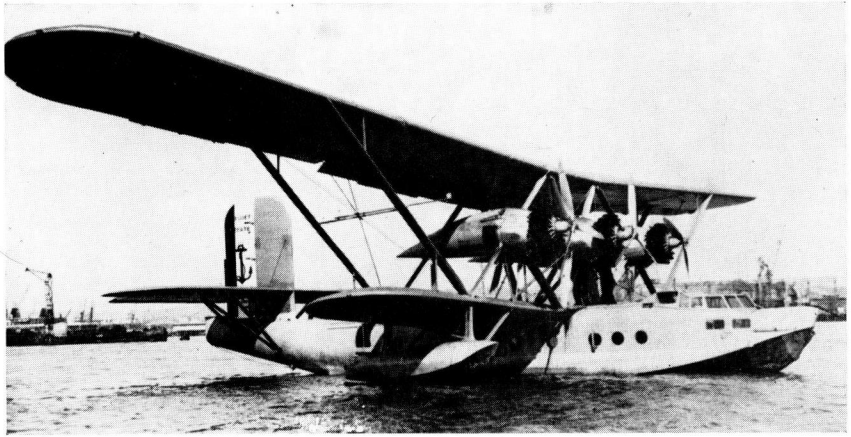


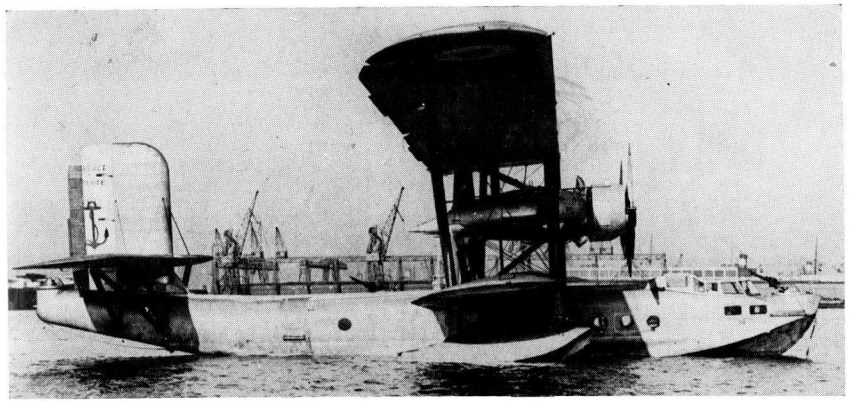
gal. Armament comprised a single 7.5-mm. Darne machine gun in each side of the forward hull, two similar guns aft of the wings, and a fifth in a tail position. The production Bizerte was powered by 900 h.p. Gnôme-Rhône 14 Kirs 1 radials, and Escadrilles E2 and E3 began converting to the flying boat before the end of 1935. Several small production orders were placed, the seventh Bizerte being delivered in March 1936, and the twelfth before the end of the year. The twelfth machine was, in fact, powered by three Hispano-Suiza 14AA radials and received the designation Br.522, but was the sole machine of this type to be completed, all other Bizertes having the Gnôme-Rhône radials. A further batch of nine machines was ordered on November 30, 1936, followed by an additional three machines on October 18,

1937, these small orders being sufficient to ensure continuity of production. On April 10, 1937, the Le Havre plant had been taken over by the S.N.C.A.du Nord, but this had no effect on Bizerte production, the 25th., 26th., 27th., and 28th. machines being delivered in September 1938.

On September 1, 1939, Escadrilles E1, E2, E3 and E5, each had either four or five Bizertes on strength, and on October 15, 1939, a further Escadrille, E9, was formed at Berre with four Bizertes. Despite the obsolescence of the design, an order for a further twelve Bizerte flying boats had been placed on September 12, 1939, these differing from earlier machines in having Gnôme-Rhône 14N-11 radials (still of 900 h.p.) driving Gnôme-Rhône airscrews, and modified equipment, including SARAM 3.11 R/T. In the event, on December 12, this order was reduced to three machines, the first of which flew in February 1940. From the beginning of hostilities, the Bizerte patrolled the Atlantic and the Mediterranean. On August 1, 1940, Escadrilles E1, E2, E3, E5, and E9 were respectively redesignated 1E, 2E, 3E, 5E and 9E, and on the 15th of that month, twenty Bizerte flying boats were still in service with the French Navy. Of these, ten were undergoing overhaul or repair, and one was awaiting scrapping. Of the five Bizerte-equipped Escadrilles, only two remained to serve with the Vichy Navy, 1E and 9E, the others being disbanded after the Armistice.

The first Bizerte was initially flown with uncowled 825 h.p. Gnôme-Rhône engines.





One of the last biplane flying boats to be used during World War II, the Bizerte was employed for air-sea rescue sorties by the Luftwaffe from Lorient and Saint Mandrier.

Escadrille 1E was sent to Karouba where it operated three Bizertes and three LeO 257bis floatplanes, and 9E operated three Bizertes and three LeO H-470 flying boats from Berre. On November 8, 1942, the latter unit had four Bizertes, and these were promptly sequestered by the German forces and, together with four additional Bizertes found in storage, issued to the Luftwaffe after the occupation of Vichy France. These were flown on air-sea rescue sorties from Lorient and Saint Mandrier.

One of the Luftwaffe Bizertes was discovered by French forces on the Mediterranean coast in August 1944, and was used for communications duties with Flottille 9FTr until withdrawn owing to lack of spares.

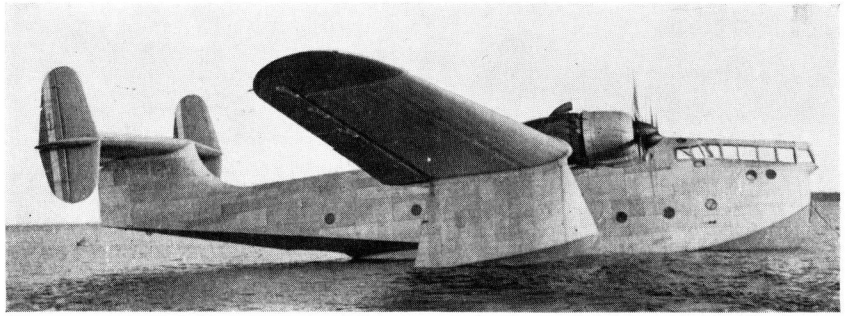
Type: *Long-range Overseas Reconnaissance Flying Boat* (*Crew:* 8). **Power Plants:** *Three* 900 *h.p. Gnôme-Rhône* 14 *Kirs* 1 *fourteen-cylinder radial air-cooled engines.* **Armament:** *Five hand-held* 7.5-*mm. Darne machine guns in two port and two starboard lateral positions and tail position, and four* 165-*lb. Type G2 bombs on underwing racks.* **Performance:** *Maximum speed,* 149 *m.p.h. at* 4,920 *ft.,* 151 *m.p.h. at* 3,280 *ft.; economical cruising speed,* 102 *m.p.h.; normal cruising speed,* 124 *m.p.h.; time to* 6,560 *ft.,* 8 *min.* 46 *sec., to* 9,840 *ft.,* 14 *min.* 30 *sec.; service ceiling,* 19,685 *ft.; normal range,* 1,305 *mls. at* 3,280 *ft.; maximum range,* 1,864 *mls.* **Weights:** *Empty,* 20,878 *lb.; loaded,* 33,271 *lb.; maximum,* 36,597 *lb.* **Dimensions:** *Span,* 115 *ft.* 3⅞ *in.; length,* 67 *ft.* 2¼ *in.; height,* 24 *ft.* 6½ *in.; wing area,* 1,750.21 *sq. ft.*

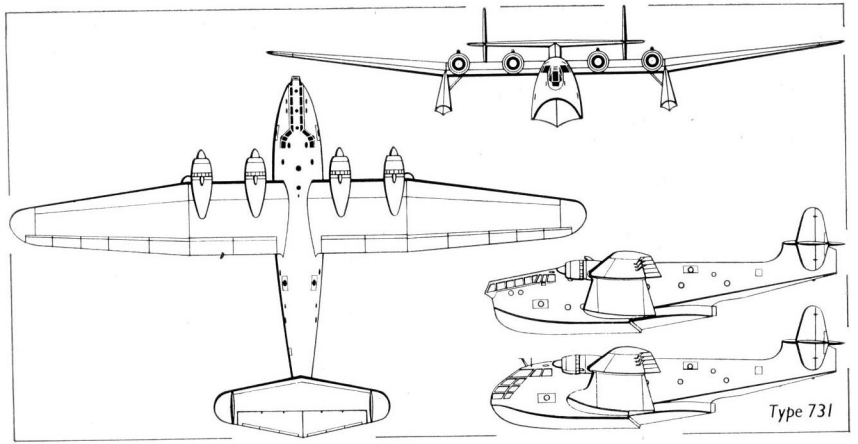
On May 10, 1935, the French Admiralty issued a specification calling for a new *hydravion de croisière* of twenty metric tons weight. Projects intended to fulfil the requirements of this specification included the C.A.M.S.141, the Laté 610, the LeO H.440 and the Breguet 710. The last-mentioned project was a large gull-wing monoplane but changes in the specification announced in December 1935 necessitated extensive redesign in order to meet the new requirements. The structure was simplified, the gull configuration of the wing was eliminated, and gross weight was increased to twenty-three metric tons. The modified project was designated Br.730, and prototype construction began in October 1936.

The box-spar wing, which housed 4,058.5 Imp. gal. of fuel, incorporated a tunnel in the leading edge through which the flight engineer could reach the engines in flight, and was built at Villacoublay, and the hull, floats and tail assembly were built at Le Havre. Engines one and three were Gnôme-Rhône 14N-2s and two and four were 14N-3s with airscrews rotating in the opposite direction, these being rated at 1,010 h.p. at 4,920 ft., and proposed armament comprised one 25-mm. cannon in a turret above and aft of the flight deck, and five 7.5-mm. Darne machine guns firing through two portholes beneath the flight deck, two portholes immediately aft of the wing, and a ventral trap aft of the rear step.

The prototype, the Br.730-01, flew for the first time on April 4, 1938, at Le Havre. A little more than three months later, however, on July 16, 1938, the prototype was disembowelled when its pilot inadvertently landed the aircraft in shallow water. Despite this accident, a contract was placed for four production machines early in 1939, and in the following September this was augmented by a further contract which called for unlimited

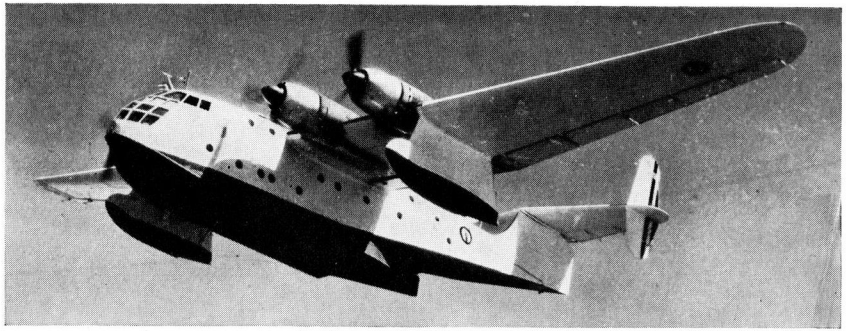
The Breguet 730 *was first flown on April* 4, 1938 *but suffered an accident ten weeks later.*





production of the flying boat. In the spring of 1940, it was decided that, as the flying boat would be operating for the most part outside the range of land-based fighters and losses should therefore be low, the planned production rate would be reduced in order that Breguet could devote more energy to the manufacture of more urgently needed combat types. At this time, hull production had been initiated at the Toulouse-Montaudran plant of the Latécoère company, at that time an associate of Breguet. The production hull differed from that of the prototype in minor respects only, and four were virtually complete when the capitulation of June 25, 1940, brought production to a halt.

Production was resumed on behalf of the Vichy government in 1941, and during the following year the hull of the first production machine and the salvaged wing of the prototype were transported to the Berre naval air station where they were mated to result in the Br.730 No.1. Powered by four 1,120 h.p. Gnôme-Rhône 14N 44/45 engines, the Br.730 No.1 was ready to fly when German forces occupied Vichy France, thus preventing tests. In the meantime, production work at Toulouse-Montaudran continued at a tempo sufficiently slow to delay the completion of further machines in case of a sudden Luftwaffe interest in the type, but not so slow as to result in the drafting of the personnel to German factories. Of the eleven hulls that had reached various stages of construction when an Allied air attack seriously damaged the plant on April 6, 1944, three survived. During the last



The Breguet 731 *differed from the original Br.*730 *in having a redesigned fuselage nose, modified stabilising floats and more powerful engines. Two Br.*730*s were completed as Br.*731*s.*

days of August 1944, the retreating German forces sabotaged the Berre naval air station but, fortunately, the Br.730 No.1 suffered only minor damage, and flight trials began on Berre Lake in December 1944.

Official acceptance trials were completed in mid-February 1945, and the Br.730 No.1, christened *Vega*, was delivered to Flottille 9FTr. One of the three hulls that had survived the bombing attack was eventually transported to Biscarosse for completion as the Br.730 No.2, this aircraft flying for the first time in May 1946, and the two remaining hulls were fitted with redesigned fuselage nose, modified floats and 1,350 h.p. Gnôme-Rhône 14R200/201, and completed under the designation Br.731. These were eventually delivered to Escadrille 33S and christened *Altair* and *Bellatrix*. These were eventually scrapped, as was also the Br.730 No.2 *Sirius*, but the Br.730 No.1 *Vega* crashed in North Africa in December 1948 when serving in the long-range communications role. The following specification relates to the Br.730 No.1.

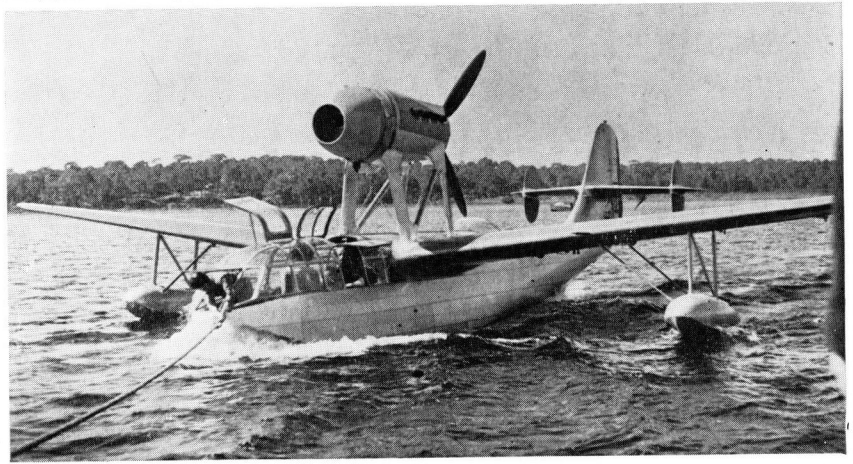
Type: *Long-range Maritime Reconnaissance and Transport Flying Boat* (*Crew:* 10). **Power Plants:** *Four* 1,120 *h.p. Gnôme-Rhône* 14*N*-44/45 *fourteen-cylinder radial air-cooled engines.* **Armament:** (*Proposed*) *One* 25-*mm. cannon in forward upper turret and five* 7.5-*mm. Darne machine guns plus four* 440-*lb. bombs.* **Performance:** *Maximum speed,* 205 *m.p.h. at* 4,920 *ft.; economical cruising speed,* 143 *m.p.h.; range* (*transport with* 19,180-*lb. payload*), 1,243 *mls.; range* (*reconnaissance*), 4,300 *mls. at* 143 *m.p.h.; endurance,* 30 *hr.; time to* 9,840 *ft.,* 9 *min.* **Weights:** *Empty,* 35,494 *lb.; maximum loaded,* 62,831 *lb.* **Dimensions:** *Span,* 132 *ft.* 5 *in.; length,* 79 *ft.* 11½ *in.; height,* 28 *ft.* 2⅜ *in.; wing area,* 1,862.15 *sq. ft.*

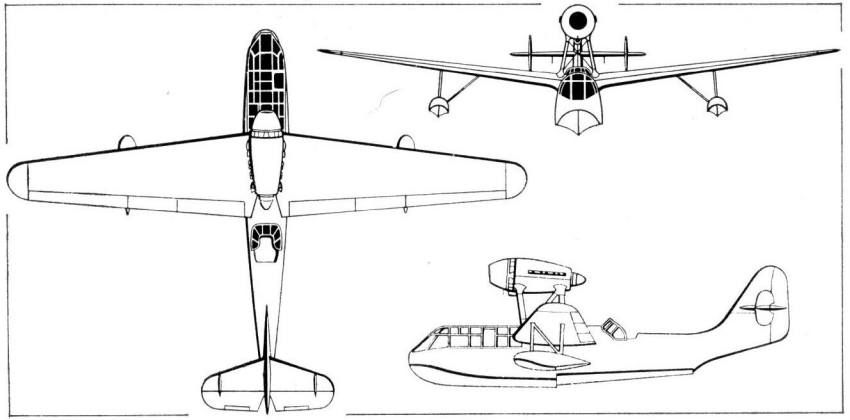
BREGUET 790 NAUTILUS — FRANCE

The Br.790 Nautilus was designed to meet the requirements of specification A46 which, issued in 1937, called for an "hydravion de surveillance côtière"—a small coastal reconnaissance aircraft. The Nautilus was of all-metal construction with a fabric-covered two-spar wing, the entire trailing edge of which was occupied by flaps, and an Hispano-Suiza 12Xirs l engine mounted on struts above the hull and driving a Ratier pusher airscrew.

An order for two prototypes of the Nautilus was placed in 1938, and the first of these was assembled at Biscarosse and flown for the first time during the summer of 1939. After initial trials, the forward portion of the hull was elongated, increasing the overall length of the flying boat from 41 ft. 5⅝ in. to 42 ft. 7 in. After the completion of this modification, the Nautilus began official evaluation trials at the C.E.P.A. at Saint Raphaël at the beginning of February 1940, and such was the promise of the aircraft that a production contract for seventy-five machines was placed almost immediately. Of these, it was anticipated that sixty would be produced by the Breguet group and the remainder

Forty-five Nautilus flying boats were on order in May 1940, *but none of these was completed.*





by the French Navy's Arsenal de Toulon.

As the Escadrilles de Surveillance were sustaining very few losses by May 1940, and greater priority was being given to land-based types urgently needed for the re-equipment of the Armée de l'Air, on the 25th of that month it was decided to reduce the production order for the Nautilus to forty-five aircraft. The second Nautilus prototype had flown for the first time in January 1940 at Biscarosse. The hull step of this prototype was moved aft to improve hydrodynamic qualities, but the ultimate fate of the two machines is unknown, and preparations for the production of the Nautilus were only in their initial stages at the time of the French collapse.

A projected variant of the Nautilus was the Br.791 with a Gnôme-Rhône 14M radial air-cooled engine, and the Br.792 was a variant which was being developed to specification A62 calling for a shipboard reconnaissance flying boat. The Br.792 was to have been powered by two 350 h.p. Béarn inverted air-cooled engines.

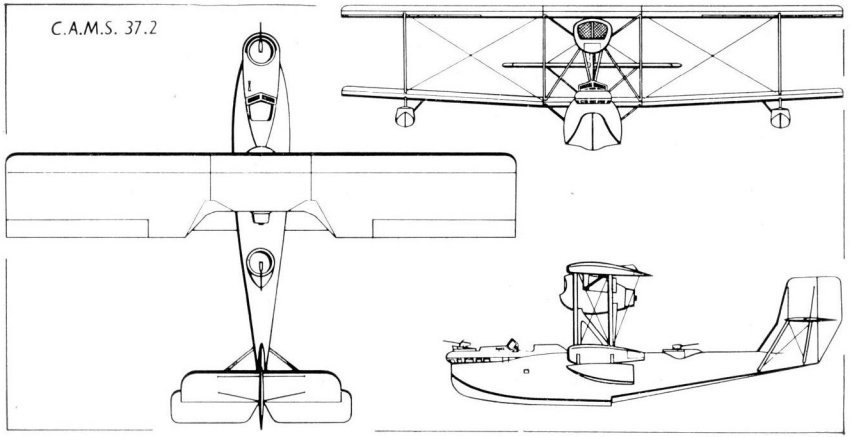
Type: *Three-seat Coastal Reconnaissance Flying Boat.* **Power Plant:** *One* 720 *h.p. Hispano-Suiza* 12*Xirs* 1 *twelve-cylinder Vee liquid-cooled engine.* **Armament:** *One hand-held* 7.5-*mm. Darne machine gun in open dorsal position and two* 165-*lb. bombs underwing.* **Performance:** *Maximum speed,* 193 *m.p.h. at* 6,890 *ft., 155 m.p.h. at sea level; economical cruising speed,* 93 *m.p.h.; service ceiling,* 19,685 *ft.; initial climb rate,* 1,437 *ft./min.; maximum endurance,* 6 *hr. at* 93 *m.p.h.* **Weights:** *Empty,* 5,952 *lb.; loaded,* 7,937 *lb.* **Dimensions:** *Span,* 55 *ft.* 9¼ *in.; length,* 42 *ft.* 7 *in.; height,* 13 *ft.* 1½ *in.; wing area,* 355.209 *sq. ft.*

Of the many elderly seaplanes still serving with the French Navy at the beginning of the Second World War, the eldest was the C.A.M.S.37 which had been designed in 1925 by Maurice Hurel of the Chantiers Aéro-Maritimes de la Seine. Intended for both shore-based and shipboard use, the C.A.M.S.-37 was entirely of wooden construction and, powered by a 400 h.p. Lorraine 12 Db twelve-cylinder Vee liquid-cooled engine installed as a pusher and braced between the wings, the prototype was flown for the first time at Sartrouville in 1926. The prototype was known as the C.A.M.S.37 R3b (the "R3b" suffix indicating *Reconnaissance triplace de bord*), but the second aircraft had a four-blade airscrew in place of the original two-blader, a 450 h.p. Lorraine 12 Eb twelve-cylinder W engine, redesigned vertical tail surfaces and an amphibious undercarriage, and was designated C.A.M.S.37A. The latter was ordered into production for the French Navy before the end of 1926, a contract for fifteen C.A.M.S.-37A amphibians being placed. Shortly afterwards, the Portuguese government ordered seven similar machines powered by the 450 h.p. Hispano-Suiza 50 (12 Gb). engine.

Several variants of the basic design were quickly produced as further production orders were received, and a commercial model, the C.A.M.S.37C, was evolved, this having the Lorraine 12 Eb engine and an enclosed cockpit accommodating four persons. One of these aircraft was modified as the C.A.M.S.37 GR (*Grand Raid*) and, between October 12, 1926 and March 9, 1927, was flown a distance of 14,042 miles around Africa by a French Navy crew. The C.A.M.S.37 GR was subsequently handed over to the Saint Raphaël naval air station for communications duties, and the prototype C.A.M.S.37A was handed over to Escadrille 4S1 at Karouba late in October 1928 for training and target-towing. The first French Navy units to operate the C.A.M.S.37A were Escadrilles 2S1, 3S1 and 4S1, and aircraft of this type were delivered to the cruiser *Tourville* and the battleship *Edgar Quinet* in 1929 and 1930 respectively, although the latter vessel passed its flying boat over to the carrier *Béarn* on August 2, 1930. The Escadrille du Donnaï was formed at Cat-Laï, Indochina, on October 1, 1930, with one C.A.M.S.37 Lia (*Liaison*), a military liaison version of the civil C.A.M.S.37C later known as the C.A.M.S.37.6, and C.A.M.S.37.2 flying boats, the latter being identical to the C.A.M.S.37A apart from having no amphibious undercarriage. This unit was eventually transferred to the Armée de l'Air as the Escadrille d'Indochine No. 5.

In May 1934, Escadrille 4S1 converted to the larger C.A.M.S.55.2, but production of the C.A.M.S.37 continued at Saint Denis, the principal models being the C.A.M.S.37.2 three-seat observation flying boat, the C.A.M.S.37.6 four-seat communications amphibian, the C.A.M.S.37.9 four-seat transport amphibian (four built), and the C.A.M.S.37.11 (sometimes known as the 37E) non-amphibious basic trainer. All variants were similarly powered and of similar construction with the exception of the C.A.M.S.37.9 which had an all-metal two-step hull. Variants tested but not placed in production included the C.A.M.S.37.3 observation amphibian with a strengthened hull, the 37.7 communications amphibian with hydraulically raised wheels, the 37.12 commercial amphibian, and the 37.13 metal-hulled ambulance.

By 1935, in addition to Escadrilles 2S1 and

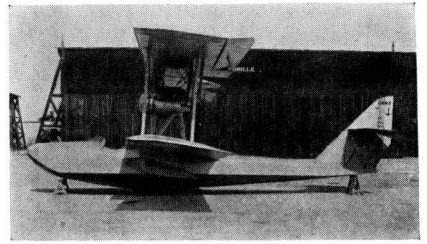


3S1, the Sections de Servitude and Sections d'Entrainement were operating the C.A.M.S.-37, one C.A.M.S.37.6 was based aboard the *Béarn*, two C.A.M.S.37A aircraft were operated by the training cruiser *Jeanne d'Arc*, and the Ecole de Pilotage d'Hourtin possessed fifteen C.A.M.S.37.11 trainers. However, in the summer of 1936, Escadrille 2S1 converted to the C.A.M.S.55.10, in 1938 3S1 converted to the Gourdou-Leseurre GL-812, and in 1939 the Escadrille d'Indochine No.5 converted to the Loire 130, and by the beginning of the Second World War, the C.A.M.S.37 had been relegated entirely to the training and communications roles. With mobilisation, two new units were formed, Escadrilles 2S2 and 2S4 at Rochefort-sur-Mer and Lanvéoc, these possessing four and three C.A.M.S.37.11 flying boats respectively, and despite the fact that these were trainers, the aircraft were used to patrol French coastal waters. Escadrille 2S4 converted to land-based aircraft early in 1940, but 2S2 continued to operate the C.A.M.S.37.11 on patrol until disbanded in August 1940.

Escadrille 8S5 based in Tahiti possessed one C.A.M.S.37.11 when it became a Free French unit in July 1940, and continued operating this until January 15, 1941, and another C.A.M.S.37 was reportedly still flying with the Armée de l'Air in Indochina in 1942.

The following specification relates to the C.A.M.S.37.2, data quoted in parentheses relating to the C.A.M.S.37.11.

Type: *Three-seat Observation* (*Four-seat Trainer*) *Flying Boat.* **Power Plant:** *One* 450 *h.p. Lorraine* 12 *Ed twelve-cylinder W liquid-cooled engine.* **Armament:** *Two* 0.303-*in. Lewis machine guns in bow position, two* 0·303-*in. Lewis guns in dorsal position and four* 165-*lb. bombs underwing.* **Performance:** *Maximum speed,* 109 (118) *m.p.h. at sea level,* 105 (114) *m.p.h. at* 6,560 *ft.; time to* 3,280 *ft.,* 8 (6) *min., to* 6,560 *ft.,* 19 (11.5) *min., to* 9,840 *ft.,* 42 (22) *min.; service ceiling,* 11,155 (12,795) *ft.; endurance,* 6 *hr. at* 3,280 *ft.; range,* (497) *mls.* **Weights:** *Empty,* 4,784 (4,696) *lb.; normal loaded,* 6,614 (6,790) *lb.; maximum,* 6,889 *lb.* **Dimensions:** *Span,* 47 *ft.* 6¾ *in.; length,* 37 *ft.* 6 *in.* (37 *ft.* 3½ *in.*)*; height,* 13 *ft.* 9⅜ in. (15 *ft.* 5¾ in.)*; wing area,* 644.757 *sq. ft.*



The C.A.M.S.37 three-seat flying boat as flown at Sartrouville during 1926.

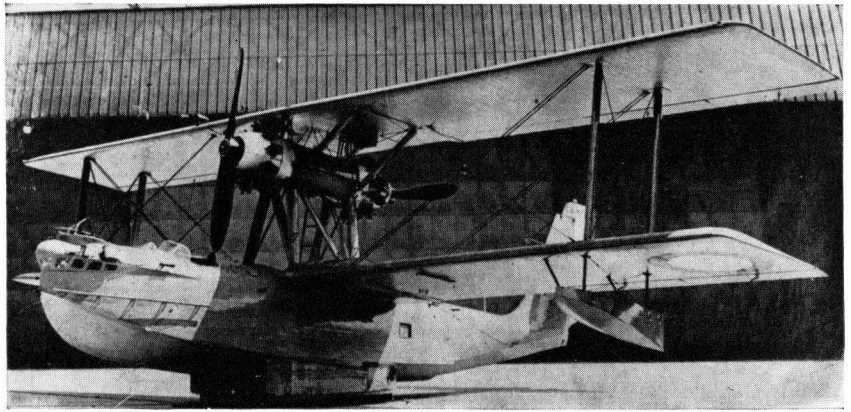
C.A.M.S.55

FRANCE

The C.A.M.S.55 five-seat maritime reconnaissance bomber was a military derivative of the successful commercial C.A.M.S.53, thirty-six examples of which were built for use on Mediterranean routes. A pre-production batch of four C.A.M.S.55 flying boats was ordered for the French Navy, the first and second machines powered by two 480 h.p. Gnôme-Rhône 9Akx Jupiters and the third and fourth powered by 600 h.p. Hispano-Suiza 12 Lbr engines. The four aircraft were built at Saint Denis, assembled at Sartrouville and flown in 1928. In the following year a batch of ten Hispano-powered machines was ordered, these being designated C.A.M.S.55.1, this contract subsequently being extended to include an additional fourteen machines powered by Jupiters and designated C.A.M.S.-55.2.

The C.A.M.S.55.1 and 55.2 were essentially similar apart from their engines and were of all-wood construction. Armament comprised twin 7.7-mm. Lewis guns in the bow and a pair of similar guns in an open dorsal turret which was arranged to move from side to side of the hull. The first units to receive the new boats were Escadrille 3E1 based at Berre which converted to the C.A.M.S.55.2 in 1930, and Escadrille 4E1 which was formed with the C.A.M.S.55.1 at Karouba during the same year. Thirty-three C.A.M.S.55.1 and fifteen C.A.M.S.55.2 flying boats followed, and the seventy-seventh machine was fitted with Jupiter engines but was 882 lb. lighter than the standard C.A.M.S.55.2, the reduced weight resulting from the introduction of a light alloy hull and light alloy stabilising floats. This aircraft was designated C.A.M.S.55.6, and the seventy-eighth aircraft was similar but had supercharged Gnôme-Rhône 9Kdrsl engines rated at 535 h.p., this aircraft receiving the designation C.A.M.S.55.14.

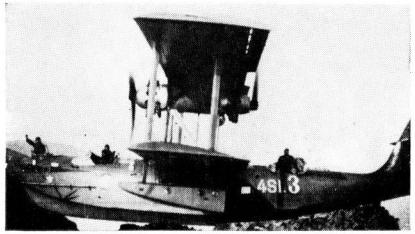
The seventy-ninth and the following eleven machines had 530 h.p. unsupercharged Gnôme-



*The C.A.M.S.*55.6 *introduced light alloy floats and hull and was* 882 *lb. lighter than the* 55.2.

Rhône 9Kbr engines and reverted to the wooden hull and stabilising floats, these being

*A C.A.M.S.*55.10 *of Escadrille* 4*S*1 *in* 1940.



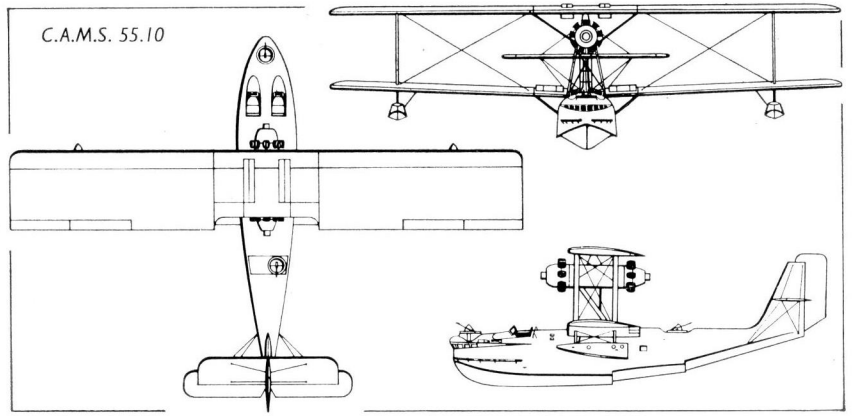
C.A.M.S.55.10s, and the next sixteen differed in having metal stabilising floats. The last four production machines, known as the C.A.M.S.55.10 Coloniaux, differed only in having SFR-AVL 20 long-range R/T equipment in place of the standard SIF-404 installation. Production of the flying boat terminated in mid-1935 with the delivery of the 110th machine, and projected variants which were not built included the C.A.M.S.55.4 with two 600 h.p. Lorraine 12Fa engines, the 55.12 with four 300 h.p. Lorraine 9Na engines, and the 55.13 with four 420 h.p. Gnôme-Rhône 9Ac Jupiters.

During the early 'thirties, Escadrilles 1E1, 3E2 and 3E3 operated the C.A.M.S.55 flying boats, but the type had been largely relegated

to second-line duties by August 1939 when mobilization added new Escadrilles de Surveillance to the peacetime units. By September 20, 1939, Escadrille 1S1 at Cherbourg had five C.A.M.S.55.10s, 2S1 at Lanvéoc-Poulmic had three C.A.M.S.55.10s, 3S4 at Berre had two C.A.M.S.55.1s and one 55.10, and 8S5 at Papeete had two C.A.M.S.55.1s. On May 10, 1940, 2S1 was operating six C.A.M.S.-55.10s, 4S1 had nine 55.10s, and 3S4 still possessed three of these flying boats, and these, despite their obsolescence, continued in service until the units were disbanded on August 1, 1940. After the capitulation, all C.A.M.S.55 flying boats were scrapped with the exception of two machines of Escadrille 20S (formerly 8S5) which continued to operate these under Free French command until January 15, 1941.

The following specification relates to the C.A.M.S.55.10.

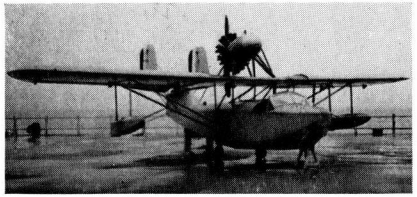
Type: *Medium-range Maritime Reconnaissance Flying Boat* (*Crew:* 5). **Power Plants:** *Two* 530 *h.p. Gnôme-Rhône* 9*Kbr nine-cylinder radial air-cooled engines.* **Armament:** *Two* 0.303-*in. Lewis machine guns in bow position and two* 0.303-*in. Lewis guns in dorsal position, plus two* 165-*lb. G2 bombs on underwing racks.* **Performance:** *Maximum speed,* 134 *m.p.h. at sea level,* 118 *m.p.h. at* 3,280 *ft.,* 114 *m.p.h. at* 8,200 *ft.; cruising speed,* 94 *m.p.h.; time to* 3,280 *ft.,* 7.5 *min., to* 6,560 *ft.,* 18 *min., to* 8,200 *ft.,* 28 *min.; service ceiling,* 11,155 *ft.; range,* 808 *mls.; endurance,* 9 *hr. at* 90 *m.p.h.* **Weights:** *Empty,* 10,231 *lb; loaded,* 14,396 *lb.* **Dimensions:** *Span,* 66 *ft.* 11 *in.; length,* 49 *ft.* 2½ in.*; height,* 18 *ft.* 4½ in.*; wing area,* 1,234.943 *sq. ft.*



C.A.O. 30

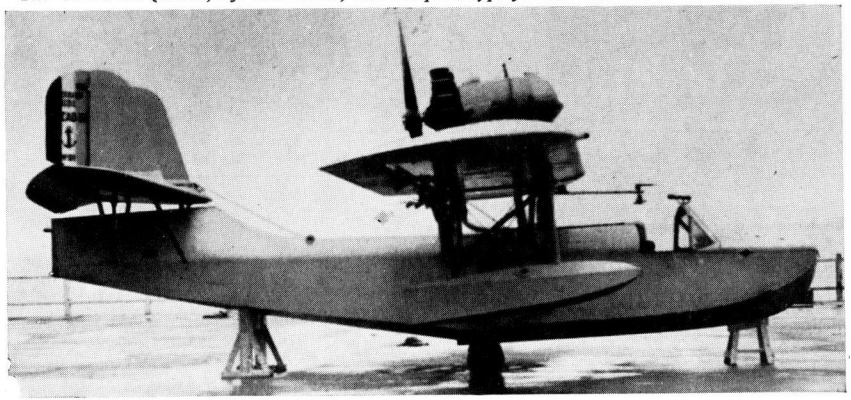
FRANCE

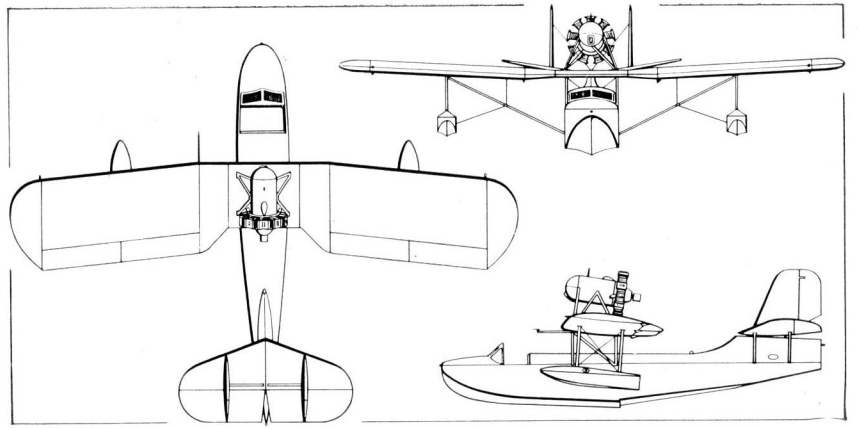
The C.A.O.30 was designed as a private venture to the French Navy's specification A49 which called for a two-seat training flying boat. The original project was designated LN-30 by the Saint Nazaire design bureau of the Loire-Nieuport company when work on the flying boat was initiated in 1937, but this designation was changed to C.A.O. 30 when the concern was absorbed by the Société Nationale de Constructions Aéronautiques de l'Ouest.



The C.A.O. 30 was primarily of wooden construction, and the pupil and instructor were seated side by side with dual controls in an open cockpit. A cockpit canopy was, in fact, designed for the flying boat but never fitted. Tanks for 48 or 69 Imp. gal. of fuel could be installed immediately aft of the cockpit, and the Salmson 9ABa engine was supported above the wing by steel-tube struts. The first C.A.O. 30 prototype was built at Saint Nazaire and flew for the first time on September 13, 1938, from the Loire estuary.

*The C.A.O.*30 (*above, left and below*) *was the prototype for the C.A.O.*300 *ordered in* 1940.





After initial trials, increased dihedral was applied to the outer wing panels, a ring cowling was added to the engine, and the tail twin fin-and-rudder assembly was supplanted by a large single fin-and-rudder assembly and circular endplate auxiliary fins. After these modifications had been effected, flight trials were resumed on December 21, 1938. A second prototype C.A.O. 30 was first flown on May 19, 1939, and official trials were undertaken by the end of that year.

On January 31, 1940 the, French Admiralty made a request to the Ministère de l'Air for the production of forty machines. In the event, the production of a batch of a dozen machines under the designation C.A.O. 300 was ordered. On March 19, 1940, the Section Hydraviation du Service Technique de l'Aéronautique requested that further tests be made at Hourtin with a wing of increased area, but in June 1940 the first C.A.O. 30 prototype was listed as unserviceable at Saint Raphaël, and the fate of the second prototype is unknown. No production C.A.O. 300 flying boats were completed.

Type: *Two-seat Training Flying Boat.* **Power Plant:** *One* 280 *h.p. Salmson 9ABa nine-cylinder radial air-cooled engine.* **Performance:** *Maximum speed,* 119 *m.p.h. at sea level; minimum speed,* 63 *m.p.h.; service ceiling,* 13,120 *ft.; time to* 9,840 *ft.,* 22 *min.; maximum endurance,* 4 *hr.* **Weights:** *Empty,* 3,031 *lb.; loaded,* 3,946 *lb.* **Dimensions:** *Span,* 42 *ft.* 7¾ *in.; length,* 30 *ft.* 2¼ *in.; height,* 10 *ft.* 6⅛ *in., wing area,* 285.244 *sq. ft.*

LATÉCOÈRE 302

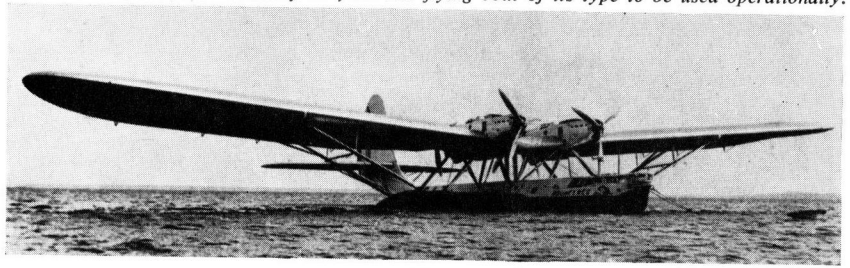
FRANCE

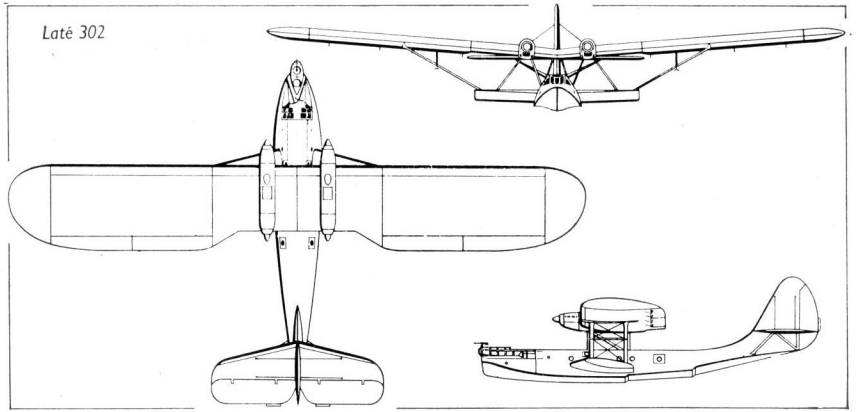
The Laté 302 long-range maritime reconnaissance flying boat was a military derivative of the Laté 300 commercial flying boat intended for use over the Dakar-Natal route. In 1928, the Ministère de l'Air prepared a specification for a four-engined flying boat with a crew of four and a 2,200-lb. commercial payload. Three prototypes were built to meet the requirements of this specification, the Blériot 5190, the LeO H-27 and the Laté 300. The last-mentioned type flew for the first time in 1931 with the registration F-AKCU but sank on the Berre lake in December of that year. Salvaged and re-built, it resumed flying trials on October 7, 1932, with the registration F-AKGF, eventually being christened *Croix-du-Sud*. On January 1, 1934, the *Croix-du-Sud* established an international distance record for seaplanes by flying from Berre to Saint Louis, Senegal, a distance of 2,357 miles. Between January 3rd and 4th, the aircraft flew the South Atlantic from Saint Louis to Natal in nineteen hours, and these spectacular flights aroused considerable interest with both the commercial operator, Air France, and with the French Navy, the latter requiring a reconnaissance flying boat with exceptional range characteristics.

The Ministère de l'Air placed an order for three machines for operation by Air France, and three examples of a military variant were also ordered for the French Navy. The commercial model was designated Laté 301, the three aircraft of this type being F-AOIK *Orion*, F-AOIL *Eridan*, and F-AOIM *Nadir*, and powered by four 650 h.p. Hispano-Suiza 12 Nbr engines, they differed from the original *Croix-du-Sud* in having redesigned accommodation, increased wing dihedral and enlarged vertical tail surfaces. These modifications had been successfully applied to the *Croix-du-Sud* during 1934–35. The three Laté 301s were assembled and test flown at Biscarosse, F-AOIK flying for the first time on September 7, 1935, and shortly afterwards it was decided to re-christen the three aircraft *Ville de Buenos Aires*, *Ville de Rio de Janeiro*, and *Ville de Santiago du Chili* respectively.

The three military aircraft followed the Laté 301s on the production line and were

The third Laté 302, the "Mouneyrès", the last flying boat of its type to be used operationally.





designated Laté 302. Structurally and dimensionally similar to the Laté 301, the Laté 302s were powered by 930 h.p. supercharged Hispano-Suiza 12Ydrs2 engines, and before the first of these was completed, the Ministère de la Marine decided, on January 20, 1936, that the three aircraft would be christened *Guilbaud*, *Cuverville* and *Mouneyrès*. The first Laté 302, *Guilbaud*, flew on February 22, 1936, but initial trials indicated that the two retractable gun turrets installed in the wings, outboard of the engine nacelles, caused tail flutter when extended, and it proved necessary to remove these before the aircraft was delivered to Saint Raphaël at the end of March for official trials. The third aircraft, *Mouneyrès*, was completed in April 1936, and the Laté 302s were delivered to Escadrille E4 at the Berre naval air station, this unit participating in naval exercises off the West African coast between January 15 and February 23, 1937. In the meantime, the Laté 301 F-AOIM *Ville de Santiago du Chile* had been acquired by the French Navy and re-christened *de l'Orza*. Military equipment was installed in August 1939 and the aircraft delivered to Escadrille E4 which, at the outbreak of hostilities, was based at Dakar.

Until German forces reached Bordeaux, Escadrille E4 patrolled the shipping routes between West Africa and the Channel approaches with its three Laté 302s and one Laté 301. The Laté 301 had left Dakar for an overhaul at Biscarosse on May 20, 1940, and was there in non-flying condition when German forces arrived. However, Escadrille E4 (redesignated 4E on August 1, 1940) continued to operate its three Laté 302s until they were grounded from lack of spares, *Cuverville* being grounded on April 30, 1941,

Guilbaud on June 13, 1941, and *Mouneyrès* during the last weeks of that year.

Type: *Long-range Maritime Reconnaissance Flying Boat (Crew: 8).* **Power Plants:** *Four 930 h.p. Hispano-Suiza 12 Ydrs2 twelve-cylinder Vee liquid-cooled engines.* **Armament:** *One 7.5-mm. Darne machine gun in the bow, two similar guns firing through lateral port-holes, plus four 165-lb. bombs on racks attached to the bracing struts.* **Performance:** *Maximum speed, 148 m.p.h. at 3,280 ft., 149 m.p.h. at 6,560 ft.; cruising speed, 115 m.p.h. at 2,950 ft.; time to 3,280 ft., 5.5 min., to 6,560 ft., 12.5 min.; service ceiling, 16,400 ft.; maximum range, 2,050 mls.; endurance, 20 hr. at 93 m.p.h.* **Weights:** *Empty, 31,548 lb.; loaded, 52,911 lb.* **Dimensions:** *Span, 144 ft. 4¼ in.; length, 85 ft. 9½ in.; height, 26 ft. 2⅛ in.; wing area, 2,755.563 sq. ft.*

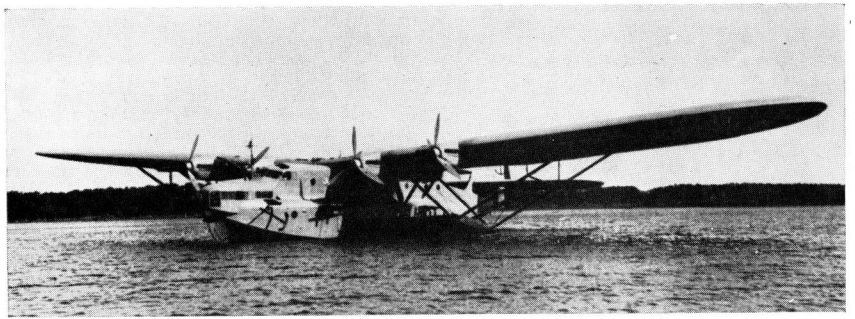
LATÉCOÈRE 521-523

FRANCE

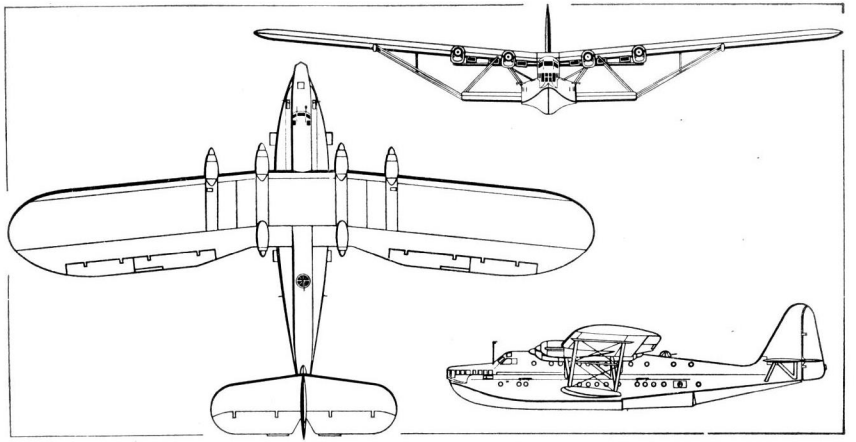
During 1930, the Latécoère design office projected a 67,460-lb. commercial flying boat powered by four 1,000 h.p. Hispano-Suiza 18Sbr liquid-cooled engines under the designation Laté 520. Unfortunately, shortly after construction of the flying boat began, the Hispano-Suiza concern discontinued work on the H.S. 18Sbr engine, and the Latécoère team was forced to redesign the boat to take six lower-powered engines. The original hull design was retained, but the wing and tail surfaces were entirely redesigned, and the designation Laté 521 applied.

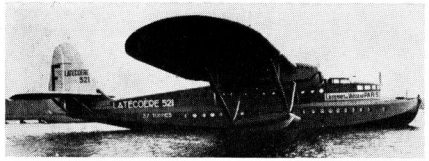
The Laté 521 was powered by six 860 h.p. Hispano-Suiza 12Ybrs driving three-blade variable-pitch airscrews, four of these being mounted in tandem pairs inboard. All-metal construction was employed, and the sponsons housed the six main fuel tanks with a total capacity of 4,905 Imp. gal., these being supplemented by two 109 Imp. gal. auxiliary tanks in the wings. Christened *Lieutenant de Vaisseau Paris*, the Laté 521 was flown for the first time in January 1935, and was intended to carry thirty passengers and eight crew members on trans-Atlantic services. A year after trials had begun, the Laté 521 was hit by a typhoon on January 14, 1936, and sank in Pensacola Bay. After salvaging, the flying boat was dismantled and shipped to France for reconstruction, and in order to increase the range of the aircraft the Laté 521 was re-engined with six 650 h.p. Hispano-Suiza 12Nbr unsupercharged engines during reconstruction, and registered F-NORD, the aircraft resumed trials during the second half of May 1937. During November 1–2, 1937, the Laté 521 raised the world seaplane distance record to 3,591.5 miles, covering this distance in 34 hr. 37 min. after taking-off at a loaded weight of 90,390 lb. On December 27 and 29, 1937, the Laté 521 created new speed-with-load records over a 1,000-km. course, carrying 22,046-lb. and 33,069-lb. loads at average speeds of 131 m.p.h. and 117 m.p.h. respectively. On December 30, 1937, the flying boat created two new load-to-altitude records by lifting 39,683 lb. to 8,530 ft., and 33,069 lb. to 11,509 ft.

These record-breaking flights confirmed the French Navy's optimism concerning the performance of the Latécoère flying boat which had resulted in a production contract for three machines under the designation Laté 523 on April 7, 1936. The Laté 523 retained the hull, wing and tail assembly of the civil Laté 521.



The Laté 523 (above and below) was a military development of the commercial Laté 521.





The Laté 521 *"Lieutenant de Vaisseau Paris" served with the French Navy until August* 1940, *having been modified for maritime reconnaissance.*

although the number of ailerons was reduced from six to four, the fuel capacity of the sponsons was reduced to 4,663 Imp. gal., and 900 h.p. Hispano-Suiza 12Y-27 engines were installed. The stepped upper contours of the hull nose were eliminated to provide for the navigator-bombardier's station in the extreme bow, provision was made for an offensive load of six 441-lb. Type K bombs and four 904-lb. Type L bombs which were attached to the hull on rails protruding fore and aft of the sponsons, and two 1,100-lb. bombs on racks attached to the wing struts. A Blanchet-Pilain dorsal turret was intended to house a 25-mm. cannon then under development by the Artillerie Navale service, and four 7.5-mm. Darne machine guns were fired through portholes in the hull.

The first Laté 523, christened *Altaïr*, was flown for the first time on January 20, 1938, and arrived at Berre for official trials on April 22nd, subsequently being transferred to Saint Raphaël. The second machine, *Algol*, flew on June 16, 1938, and the third, *Aldebaran*, followed on October 21st. The three Laté 523s were delivered to Escadrille E6, and a prototype of the 25-mm. AN cannon was test-fired from the *Algol* on September 11, 1938, but immediately jammed and was removed. Firing trials with the cannon aboard the *Algol* were eventually resumed on June 9, 1939.

In the meantime, a further aircraft had been ordered by the Ministère de l'Air for operation by Air France-Transatlantique. Designated Laté 522 and christened *Ville de Saint Pierre*, this aircraft, F-ARAP, was similar to the Laté 523, apart from the engines which were 970 h.p. Hispano-Suiza 12Y-37s and internal arrangements, and was flown for the first time on April 20, 1939.

On September 1, 1939, Escadrille E6 was based at Lanvéoc-Poulmic with the three Laté 523s. The Laté 521 which, re-engined with H.S. 12Y-37s, had been impressed by the French Navy, and the Laté 522 equipped Escadrille E12. While flying a patrol over the Atlantic on September 18, 1939, *Algol* made a forced landing and as towing was impossible had to be sunk by gunfire. At the end of September 1939, Escadrille E6 received the Laté 521 and Laté 522, the latter, which, in the following month, was flown to Biscarosse to receive military equipment, joining operations on November 10, 1939. After several patrols, it was re-engined in December with H.S. 12Y-27s, and the Laté 521 was similarly modified. In February 1940 the Navy was asked to hand back the Laté 522 for civil use, and after logging sixty-five operational flying hours with Escadrille E6, it reverted to H.S. 12Y-37 engines and was handed back to Air France-Transatlantique in March 1940. The Laté 522 spent April and May undergoing overhaul at Biscarosse from where it escaped to Port Lyautey on June 24, 1940. Meanwhile, the surviving two Laté 523s and the Laté 521 continued patrolling the Atlantic. Laté 523 *Aldebaran* was undergoing an engine overhaul when the German forces occupied Lanvéoc, and the flying boat was scuttled there on June 18, 1940. The remaining Laté 523 and the Laté 521 were at moorings at Port Lyautey, and these flying

boats subsequently equipped Escadrille 6E (the former E6), together with the Potez-C.A.M.S.141 *Antarès* and the Laté 611 *Achernar*.

The Laté 521 was demobilised in August 1940, but the Laté 523 was flown to Berre where, between April and May 1941, it was overhauled and the wings re-skinned. It flew to Dakar on June 21, 1941, where it was delivered to Escadrille 4E, finally being grounded in August 1942. The Laté 521 and 522 were damaged beyond repair in August 1944 when the retreating German forces dynamited the hangars at Berre.

The following specification relates to the Laté 523.

Type: *Long-range Maritime Reconnaissance Flying Boat (Crew:* 14). **Power Plants:** *Six* 900 *h.p. Hispano-Suiza* 12 *Y-27 twelve-cylinder Vee liquid-cooled engines.* **Armament:** *One* 7.5-*mm. Darne machine gun in dorsal turret and four* 7.5-*mm. guns firing laterally through portholes, plus eight* 165-*lb. and four* 330-*lb. bombs.* **Performance:** *Maximum speed,* 161.5 *m.p.h. at* 3,280 *ft.; cruising speed,* 127 *m.p.h. at* 3,280 *ft.; maximum economical cruising speed,* 112 *m.p.h.; maximum endurance (with* 5,830 *Imp. gal. of fuel and without bomb load),* 33 *hr.* **Weights:** *Empty,* 45,944 *lb.; normal loaded,* 82,673 *lb.; maximum loaded,* 92,594 *lb.* **Dimensions:** *Span,* 161 *ft.* 9⅛ *in.; length,* 103 *ft.* 8⅞ *in.; height,* 31 *ft.* 9⅞ *in.; wing area,* 3,552.09 *sq. ft.*

LATÉCOÈRE 611

FRANCE

Designed to meet the requirements of the specification issued on May 10, 1935, by the French Admiralty for a long-range maritime reconnaissance flying boat of twenty metric tons weight, the Laté 610 was to have been powered by four 1,000 h.p. Hispano-Suiza 79.02 radials, and one prototype was ordered early in 1936. Changes in the specification announced in December 1935 had, however, necessitated extensive redesign, and the designation of the flying boat was changed to Laté 611. The single fin-and-rudder assembly of the original project was replaced by twin fins and rudders, overall span was increased from 124 ft. 8 in. to 133 ft. 0½ in., length was increased from 80 ft. 4½ in. to 88 ft. 9 in., and gross weight was raised to twenty-five metric tons. Construction had begun at Toulouse when it was decided to install 1,010 h.p. Gnôme-Rhône 14N4/5 engines in place of the Hispano-Suiza units.

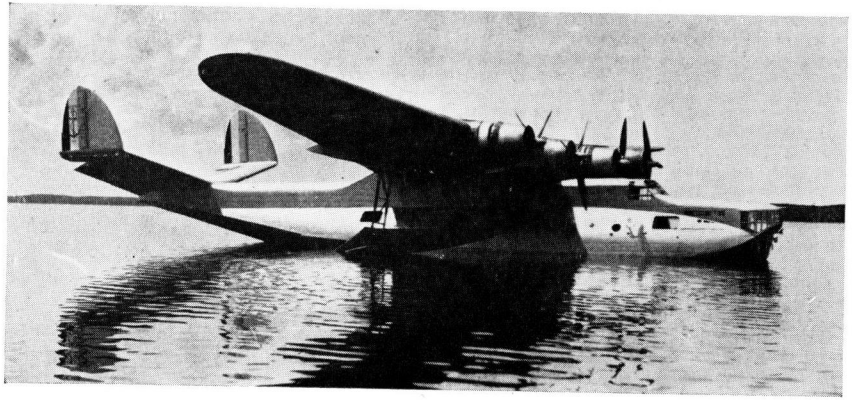
The Laté 611 was a rather elegant cantilever monoplane with electrically operated retractable stabilising floats. Construction was all-metal, and planned defensive armament comprised two forward-firing 13.2-mm. Hotchkiss machine guns in the centre section leading edge, a 25-mm. cannon in a dorsal turret, four 7.5-mm. Darne machine guns firing through portholes, and two similar guns in a retractable tail position. Assembled at Biscarosse, the Laté 611 began water trials on March 2, 1939, flying for the first time on March 8th. By July 1, 1939, when tests were stopped to permit various modifications to be made, the flying boat had logged 18 hr. 15 min. during the course of fourteen flights. The modifications included the substitution of Gnôme-Rhône 14N30/31 engines for the original 14N4/5s, these differing in reduction gear ratio, and the replacement of the leading edge mounting for twin 13.2-mm. guns by one

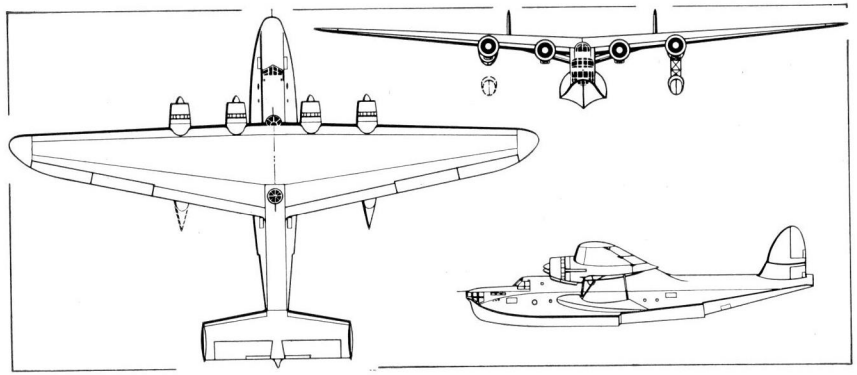
for a single 7.5-mm. Darne machine gun.

Trials were resumed briefly on November 15, 1939, but stopped again eleven days later for further modifications, including the installation of a dorsal turret housing a pair of 7.5-mm. guns owing to the failure of the 25-mm. cannon originally scheduled for installation. On December 23, 1939, the French Admiralty announced its decision to order ten examples of a modified version, the Laté 612. This model was to have differed from the prototype in having four Pratt and Whitney S3C4-G radials and four 7.5-mm. Darne machine guns in power-operated dorsal and tail turrets. Flight trials with the Laté 611 were resumed on March 16, 1940, and 81 hr. 40 min. of flying time had been logged during thirty-three flights by April 12th, when the aircraft was handed over to the French Navy and christened *Achernar*.

The Laté 611 was flown to North Africa late in June 1940 and, subsequently, under the terms of the Armistice, all armament was removed. The flying boat suffered some damage to its hull and water rudder when another flying boat collided with it as it lay at its moorings at Port Lyautey on July 29, 1940. Provisional repairs were made and authorization given on September 26th by the Italian Armistice Commission for the aircraft to be flown to Berre for definitive repairs. On May 10, 1941, the Laté 611 took-off from Berre on a communications flight to Djibouti, but again misfortune dogged the aircraft for a float was damaged while landing at Djibouti necessitating its return to Berre for further repairs.

The Laté 611 *began trials in March* 1939, *and ten examples of a modified version were ordered in the following December. Christened "Achernar", the Laté* 611 *was flown until* 1947.





On October 15, 1941, after repairs had been completed, the Laté 611 was flown from Berre to Port Lyautey and afterwards to Dakar where it joined Escadrille 4E to serve in its original long-range reconnaissance role. In November 1942, Escadrille 4E resumed patrols in the South Atlantic, and enlarged as Flottille 7F in October 1943, this unit continued to operate the Laté 611 alongside Sunderlands. Shortly before the Allied landings in Southern France, the twin tail-mounted Darne machine guns were supplanted by a single 0.5-in. Browning, and two additional Brownings were mounted in the dorsal turret. Late in August 1944, the Laté 611 was nearly lost when its pilot attempted to alight by mistake in a bay on the Southern French coast which was still occupied by German forces. Fortunately, the German small-arms fire was inaccurate and the flying boat escaped.

Flottille 9FTr was formed at Saint Mandrier for communications duties on December 5, 1944, and the Laté 611 was transferred to this unit, eventually being grounded in February 1947, after having logged 1,600 hours in the air, 620 hours of which were spent on shipping escort duties.

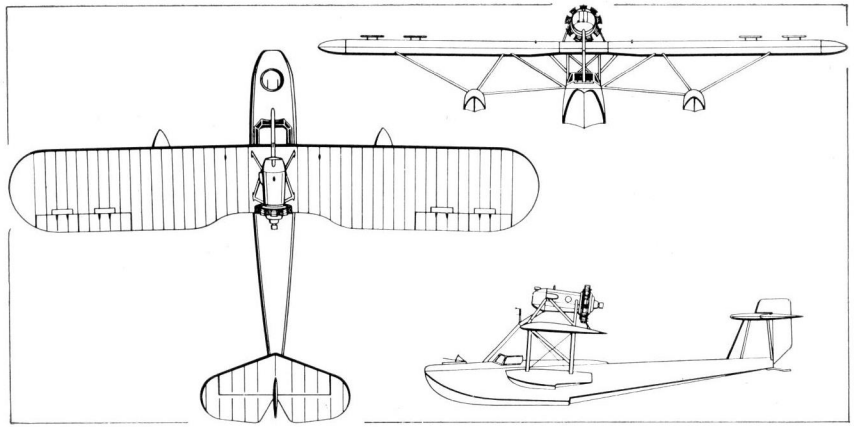
Type: *Long-range Maritime Reconnaissance Flying Boat.* **Power Plants:** *Four* 1,010 *h.p. Gnôme-Rhône* 14*N*30/31 *fourteen-cylinder radial air-cooled engines.* **Armament:** *Four* 7.5-*mm. Darne machine guns firing laterally through portholes, two* 0.5-*in. Browning guns in dorsal turret, and one* 0.5-*in. Browning gun in tail, plus a* 1,764-*lb. bomb load.* **Performance:** *Maximum speed,* 217 *m.p.h. at* 3,280 *ft.; climb to* 6,560 *ft.,* 10 *min.; maximum endurance (patrol),* 33 *hr. at* 112 *m.p.h.; maximum range (transport),* 2,640 *mls.* **Weights:** *Empty,* 35,274 *lb.; normal loaded,* 58,422 *lb.; maximum,* 68,343 *lb.* **Dimensions:** *Span,* 133 *ft.* 0½ *in.; length,* 88 *ft.* 9 *in.; height,* 25 *ft.* 1 *in.; wing area,* 2,098.96 *sq. ft.*

(*Above and below*) *The original Loire* 50.

In 1930, the aeronautical division of the Ateliers et Chantiers de la Loire initiated the design of a small three-seat multi-purpose amphibian flying boat intended for military communications and training, and for mail-carrying and survey in France's overseas territory. Designated Loire 50 and powered by a 230 h.p. Salmson 9AB air-cooled radial braced above the high wing and driving a two-blade airscrew, the first prototype flew on September 7, 1931. The aircraft was of light alloy construction, the folding outer wing panels being fabric-covered, and dual controls being provided.

Initially flown without the amphibious landing gear, the Loire 50 sank in shallow water as the result of an accident on October 1, 1931. The prototype was salvaged and, after repairs, was flown to Saint Raphaël on January

The production Loire 501 *did not differ externally from the Loire* 50 *prototype* (*below*).



15, 1932, for official trials. Six months later, the aircraft was delivered to Hourtin where it entered service with the naval flying school. On February 20, 1933, the Loire 50 was returned to Saint Raphaël for further trials and, on June 18th, was returned to the Loire works at Saint Nazaire for modifications. It was re-engined with a 350 h.p. Hispano-Suiza 9Qd power plant and, with other modifications, was redesignated Loire 50bis, flying in this form for the first time on October 18, 1933.

A production batch of six aircraft had been ordered earlier in 1933 and, similar to the Loire 50bis, these were designated Loire 501, production deliveries beginning before the end of the year. The aircraft were delivered to the Sections de Servitudes of various naval air stations. Several remained in service with the French Navy for communications duties during the early months of the war, but on August 15, 1940, only one Loire 501 remained, this being based at Karouba. A proposed variant with a 300 h.p. Lorraine 9Na engine was designated Loire 502.

Type: *Three/four-seat Communications and Liaison Flying Boat.* **Power Plant:** *One* 350 *h.p. Hispano-Suiza* 9*Qd nine-cylinder radial air-cooled engine.* **Performance:** *Maximum speed,* 121 *m.p.h. at* 3,280 *ft.,* 117 *m.p.h. at* 6,560 *ft.,* 107 *m.p.h. at* 13,120 *ft.; cruising speed,* 87 *m.p.h.; climb to* 3,280 *ft.,* 4 *min., to* 6,560 *ft.,* 10 *min., to* 9,840 *ft.,* 16 *min.; service ceiling,* 15,910 *ft.; maximum range,* 683 *mls.* **Weights:** *Empty,* 3,053 *lb.; loaded,* 4,740 *lb.* **Dimensions:** *Span,* 52 *ft.* 6 *in.; length,* 36 *ft.* 4¼ *in.; height,* 14 *ft.* 8 *in.; wing area,* 424.097 *sq. ft.*

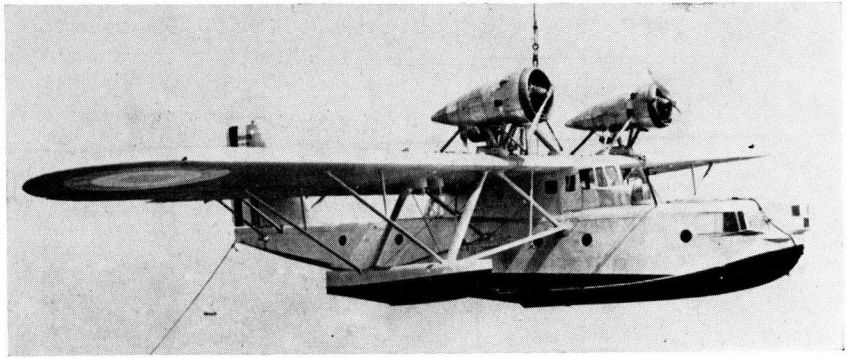
LOIRE 70

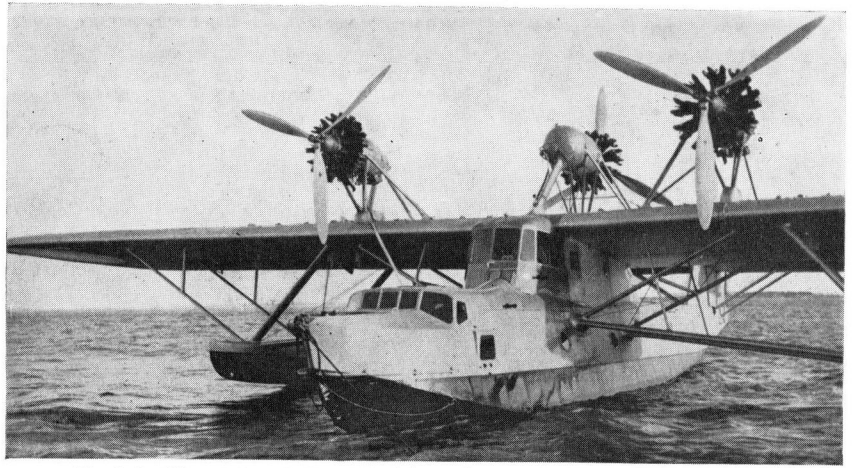
FRANCE

The Loire 70 maritime reconnaissance flying boat was designed by the aeronautical division of the Ateliers et Chantiers de la Loire to meet a French Navy requirement formulated in 1932, and the first prototype, powered by three 500 h.p. Gnôme-Rhône 9Kbr radials, two mounted as tractors and one as a pusher, was flown for the first time on December 28, 1933. Of all-metal construction, the Loire 70 carried eight crew members, and at an early stage in its flight trials, the three-blade Ratier airscrews were supplanted by two-blade airscrews of smaller diameter and of Gnôme-Rhône manufacture. On June 22, 1934, the prototype was flown to Saint Raphaël for official trials, and on December 29, 1934, the French Admiralty placed an order for seven production Loire 70s.

The test at Saint Raphaël indicated that the prototype was underpowered, and the aircraft was therefore re-engined with three 740 h.p. Gnôme-Rhône 9Kfr engines, the two tractors driving two-blade airscrews and the pusher driving a three-blader. Simultaneously, the bow gun position was eliminated and the position for the bombardier-navigator redesigned and placed in the extreme nose, a stepped, enclosed turret being positioned immediately ahead and below the flight deck. After these modifications further trials were undertaken, including an endurance tour in the Western Mediterranean which took place in April 1936. On October 26, 1936, further modifications were ordered, these comprising the enlarging of the tail surfaces and an increase in total fuel capacity from 924 Imp. gal.

The Loire 70 *equipped Escadrille E7 at the beginning of W.W.II, this unit having all seven production examples of this flying boat, together with the original prototype.*





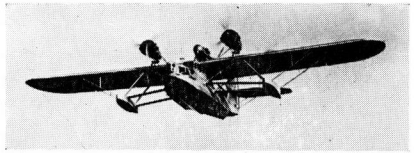
The Loire 70 *prototype in its original form photographed in the summer of* 1934.

to 1,232 Imp. gal.

In the meantime, production of the Loire 70 had been progressing at Saint Nazaire, and the hulls of the first three machines had been completed in January 1936, the first production flying boat entering service in June 1937 with Escadrille E7 at Karouba, this type progressively supplanting the C.A.M.S.55 flying boats previously operated by the unit. The seventh and last production Loire 70 was delivered to Karouba on June 15, 1938. The production Loire 70 had three-blade airscrews for all engines, and whereas the tractor engines were cowled, the pusher was uncowled.

At the beginning of the Second World War, Escadrille E7 had seven Loire 70s on strength, including the original prototype which had been brought up to production standards, one machine having been written off. The Loire 70s patrolled the Mediterranean from the beginning of hostilities, but only four remained on strength by June 12, 1940, when the Regia Aeronautica attacked Karouba, destroying one Loire 70 and damaging two others beyond repair. Thus Escadrille E7 was left with only one serviceable flying boat, and on August 1, 1940, the unit was disbanded.

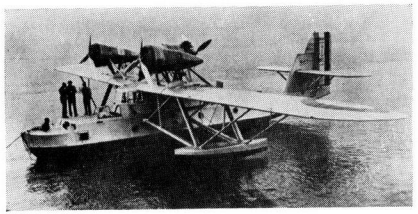
One of the Loire 70s was temporarily re-engined with three 750 h.p. Hispano-Suiza 9Vbrs engines and redesignated Loire 701, but after flight trials the aircraft was reconverted as a standard Loire 70.

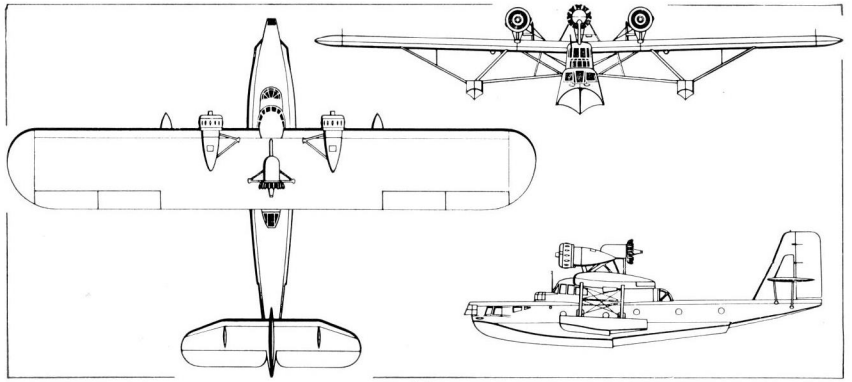


(*Above*) *A production Loire* 70 *flying boat.*

Type: *Maritime Reconnaissance Flying Boat* (*Crew:* 8). **Power Plants:** *Three* 740 *h.p. Gnôme-Rhône* 9*Kfr nine-cylinder radial air-cooled engines.* **Armament:** *Six* 7.5-*mm. Darne machine guns* (*two firing from lateral positions in the bow, one in the forward turret, one in the dorsal turret, and two firing through rear hatches*) *plus four* 330-*lb. bombs.* **Performance:** *Maximum speed,* 146 *m.p.h. at sea level,* 143 *m.p.h. at* 6,560 *ft.,* 140 *m.p.h. at* 9,840 *ft.; economical cruising speed,* 102.5 *m.p.h.; time to* 3,280 *ft.,* 6 *min., to* 6,560 *ft.,* 13 *min.* 48 *sec., to* 9,840 *ft.,* 21 *min.* 6 *sec.; service ceiling,* 13,120 *ft.; range,* 1,865 *mls.* **Weights:** *Empty,* 14,330 *lb.; loaded,* 23,148 *lb.; maximum,* 25,353 *lb.* **Dimensions:** *Span,* 98 *ft.* 5⅛ *in.; length,* 63 *ft.* 11¾ *in.; height,* 22 *ft.* 1¾ *in.; wing area,* 1,463.89 *sq. ft.*

(*Below*) *Prototype Loire* 70 *with cowled engines.*



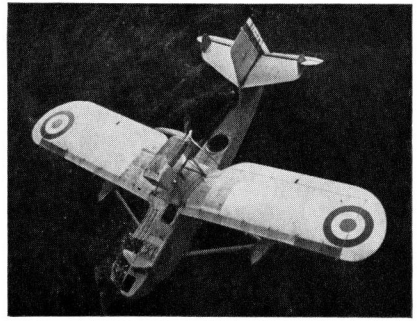


LOIRE 130

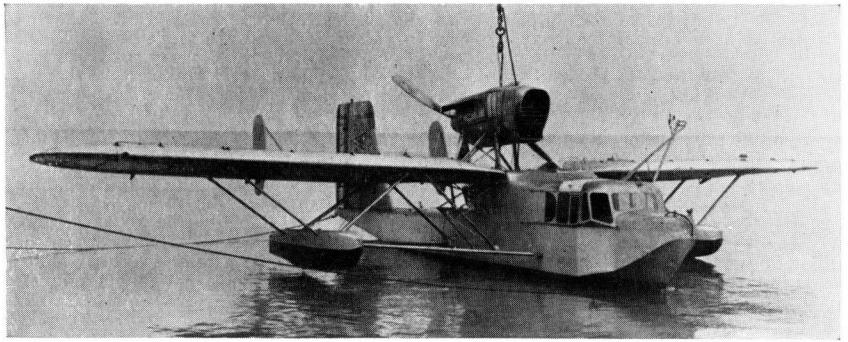
FRANCE

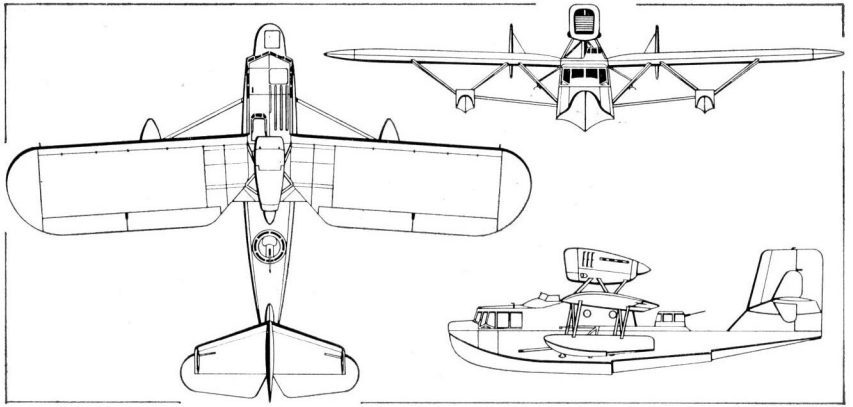
Probably the most widely used of French wartime flying boats was the Loire 130, a small multi-purpose seaplane designed to meet a 1933 specification calling for a "hydravion de surveillance catapultable". This specification resulted in a closely fought contest in which the prototypes of no less than six seaplanes participated. In addition to the Loire 130, the Breguet 610, the Gourdou-Leseurre GL-820, the Levasseur PL-200, the Lioré-et-Olivier H-43, and the C.A.M.S.120 were built to meet the requirement, and it was not until August 1, 1936, that the success of the Loire 130 was acknowledged with an initial production order for forty-five machines.

The Loire 130 prototype was flown for the first time on November 19, 1934, and, powered by a 720 h.p. Hispano-Suiza 12Xbrsl engine, was of all-metal construction with fabric-covered mainplanes and tail surfaces. Three crew members were normally carried, but provision was made to accommodate four



(*Above, right and below*) *The Loire* 130 *prototype which first flew on November* 19, 1934.





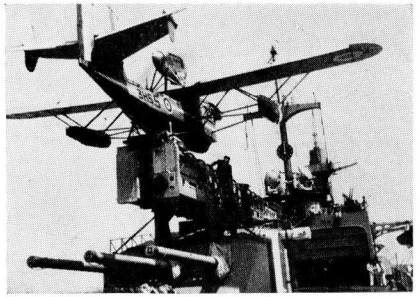
passengers for communications duties, and the wing mainplanes could be folded for shipboard stowage. During trials, the auxiliary vertical surfaces near the tips of the tailplane were enlarged, and the radiator was redesigned. The initial production order called for forty Loire 130M (Métropole) and five Loire 130C (Colonial) flying boats, the latter featuring a larger radiator, a reinforced structure to permit shallow dive-bombing attack with an OPL 38 bombsight and other equipment specifically for tropical operations. The Loire 130M was faster by 12 m.p.h. and carried an armament of two 7.5-mm. Darne machine guns and two 165-lb. G2 bombs, but both variants were powered by the Hispano-Suiza 12Xirsl, the output of which was similar to that of the engine installed in the prototype. An order for a further ten Loire 130 boats was placed in 1936, and supplementary orders for twenty and nineteen machines were placed on March 19, 1937 and October 21, 1938. The last order called for the Loire 130C version, twelve of these being intended for Armée de l'Air units overseas.

At the beginning of the Second World War, the Loire 130 was serving aboard the seaplane carrier *Commandant Teste*, the battleships *Dunkerque* and *Strasbourg*, the training cruiser *Jeanne d'Arc*, ships of the 1st, 2nd, 3rd and 4th Cruiser Divisions, and with shore-based Escadrilles 1S1 and 3S6. Escadrille 1/CBS of the Armée de l'Air in Indochina operated the Loire 130, and between December 1939 and February 1940, Escadrilles 8S2, 8S3 and 8S4 were formed with Loire 130s at Fort-de-France in the West Indies, at Dakar and at Tripoli. All these units were still operating the Loire 130 at the beginning of the German offensive of May 1940, although on the 23rd

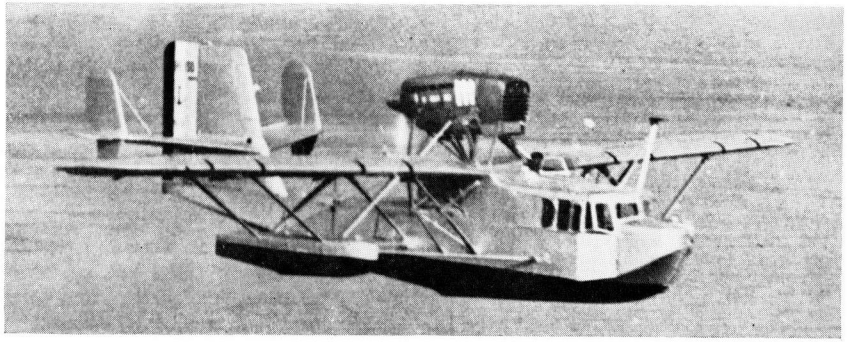
of that month Escadrille 1S1 was converting to the Laté 298 floatplane as its bases, Cherbourg and Boulogne, were within range of enemy aircraft.

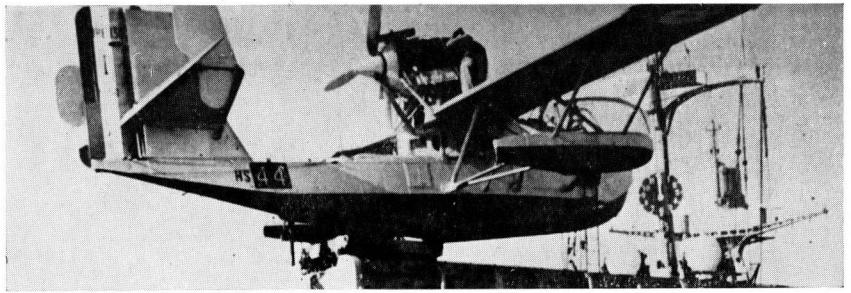
On August 1, 1940, the French Navy had a strength of sixty-two Loire 130s, of which six were with Escadrille 17S, three with 18S, six with 19S, one at Saigon, twenty-one aboard various ships, and eleven with Escadrille 1HS which had disembarked from the *Commandant Teste*, this unit being disbanded during the following month. Escadrille 18S was also disbanded on August 30, 1940, and its equipment was divided at Dakar between Escadrille 4E and the battleship *Richelieu* which had escaped from Saint Nazaire before completion. One Loire 130 escaped from Karouba to Malta in the autumn of 1940, and during February 1941, a Loire 130 carrying three crews flew from Martinique to the British West Indies and another flew from Tripoli to Palestine.

After November 8, 1942, all French warships were deprived of their catapults in order to permit the installation of supplementary anti-aircraft guns, and the Loire 130s were



(Above, right) Loire 130 *No.* 24 *of Escadrille* 3*HS of the Vichy Navy, and (below) an early production machine.*





shore-based, being used for coastal patrol, training and communications duties. On November 2, 1943, fifteen Loire 130s, including the original prototype, were based at the Dakar-Bel Air naval air station, and six of these formed an observation flight of the Sunderland-equipped 7e Flottille d'Exploration. However, the Loire 130s were progressively grounded as a result of a lack of spares. Nevertheless, a number of flying boats of this type survived the conflict for, although the French Admiralty had decided, in September 1945, not to undertake any further overhauls of the Loire 130, the flying boat training school, Escadrille 53S, was still operating four Loire 130s at Hourtin in the autumn of 1947, and one aircraft of this type was still reportedly flying in Indochina with Escadrille 8S on December 31, 1949!

The exact quantity of Loire 130s built is unknown, but it is improbable that all of the 150 flying boats of this type ordered at the beginning of 1940 were delivered, although the Saint Nazaire plant completed thirty Loire 130s for the Vichy Navy before switching to production of the Arado Ar 196 floatplane. A wooden wing was built by the Saint Nazaire plant and fitted to the eighteenth production Loire 130 for test purposes was first flown on November 20, 1939, the use of wooden wings having been first considered in the previous October as a means of conserving strategic materials, but this scheme was never adopted.

The following specification relates to the Loire 130M.

Type: *Three-seat Shipboard or Shore-base Observation Flying Boat or Seven-seat Communications Flying Boat.* **Power Plant:** *One* 720 *h.p. Hispano-Suiza* 12*Xirsl twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two* 7.5-*mm. Darne machine guns in bow and dorsal positions, and two* 165-*lb. bombs.* **Performance:** *Maximum speed,* 137 *m.p.h. at* 6,890 *ft.; cruising speed,* 102 *m.p.h. at* 4,920 *ft.; climb to* 9,840 *ft.,* 12 *min.; service ceiling,* 19,685 *ft.; maximum endurance,* 7.5 *hr. at* 93 *m.p.h. at* 1,640 *ft.* **Weights:** *Empty,* 4,519 *lb.; loaded (catapult launching),* 7,187 *lb.; maximum,* 7,716 *lb.* **Dimensions:** *Span,* 52 *ft.* 5⅞ *in.; length,* 37 *ft.* 0⅞ *in.; height,* 12 *ft.* 7½ *in.; wing area,* 410.858 *sq. ft.*

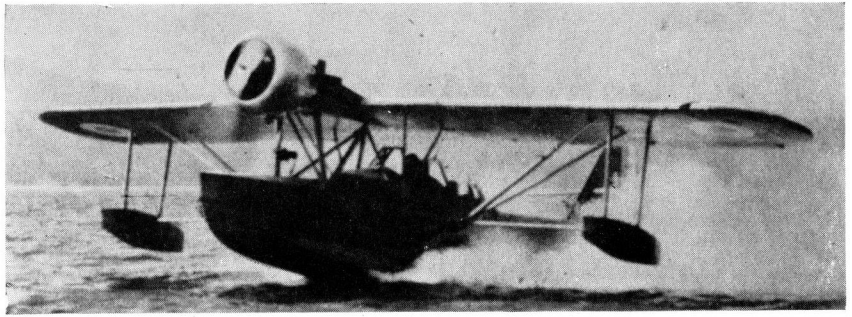
POTEZ 452

FRANCE

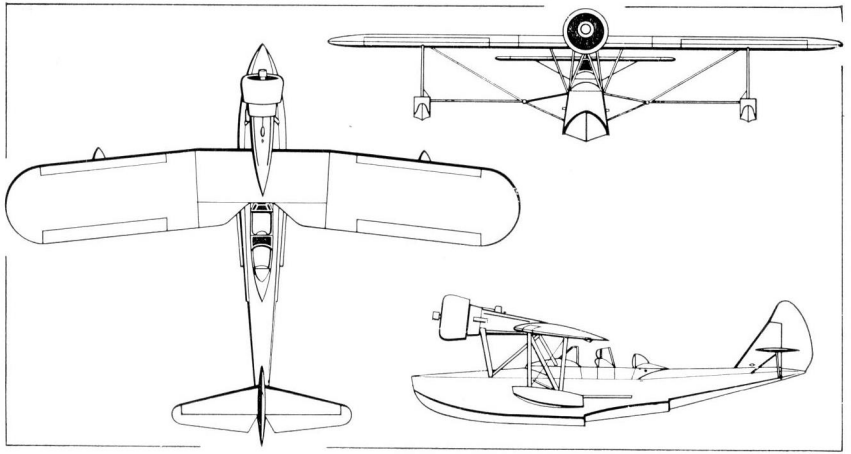
The Potez 452 was the Hispano-Suiza 9Qd-powered production model of the Potez 450 which, like the Bodiansky 30, C.A.M.S.90, Gourdou-Leseurre GL-831 and Levasseur PL-12, had been built to meet a 1930 requirement for a two-seat shipboard observation seaplane with folding wings. Designed under the direction of M. Delaruelle at Méaulte, the Potez 450 was of mixed construction and powered by a 230 h.p. Salmson 9AB engine. It flew for the first time from the Berre lake in April 1932, but after initial trials, the stub wings were deleted, the stabilising floats repositioned further outboard, and the floats themselves were redesigned. Further trials were conducted with complete success, and on September 5, 1932, the Potez 450 was delivered to Saint Raphaël for official trials.

Subsequently, the hull bow was redesigned to improve hydrodynamic characteristics, the stabilising floats again redesigned and a 350 h.p. Hispano-Suiza 9Qd engine installed. With these and other modifications, the flying boat was redesignated Potez 452, and an order for ten machines was placed in 1935, production being initiated at the C.A.M.S. plant at Sartrouville. Production machines differed externally from the prototype in having an enlarged rudder, and on February 10, 1936, the tenth production machine was flown to Barcelona for evaluation by the Spanish Navy. The Spanish government acquired a manufacturing licence for the Potez 452, but production in Spain did not begin owing to the start of the Civil War. In the meantime, deliveries of the Potez 452 had begun to the battleship *Lorraine* and to several cruisers.

In May 1936, it was decided to supplant the



The Potez 452 *undergoing trials on the Berre Lake. Sixteen production aircraft were built.*

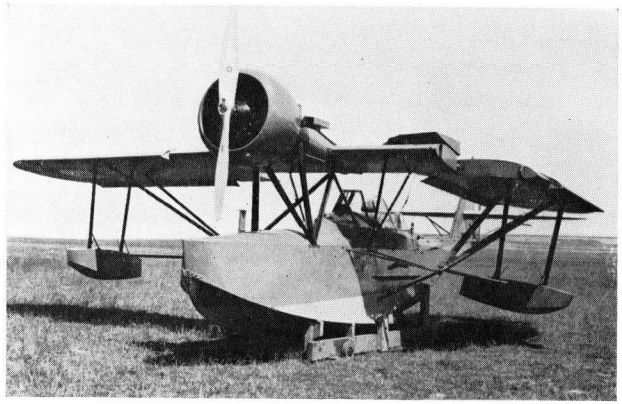


obsolescent 0.303-in. Lewis machine gun in the observer's cockpit by a 7.5-mm. Darne gun, and on June 6, 1936, an order was issued for the reinforcement of the hulls of all existing Potez 452s. On October 6, 1936, an order was placed for an additional six Potez 452s, and in the following month, the newly-commissioned cruiser *Jean de Vienne* was issued with one Potez 452 and two Gourdou-Leseurre GL-812 floatplanes, this same mixed equipment being issued to the sistership, *La Galissonnière*. Some tropical sloops were also issued with the Potez 452 which were lowered onto the water and retrieved by crane as these vessels were not equipped with catapults.

On September 20, 1939, four Potez 452s were serving with the French Navy in the Far East, two being aboard the cruiser *Lamotte-Picquet*, one being aboard a sloop and the other being held in reserve at Saigon. Two more Potez 452s were serving aboard independent sloops and a third was aboard the cruiser *Duguay-Trouin*. On August 15, 1940, the inventory of French naval aircraft included six Potez 452s, two of these still being aboard the *Lamotte-Picquet*, one being aboard the sloop *Amiral Charner*, two being at Berre and one being at Port Lyautey. The last-mentioned Potez 452 was still at Port Lyautey on November 7, 1942, at which time it was believed to be the last example of its type in existence.

Type: *Two-seat Shipboard Observation Flying Boat.* **Power Plant:** *One* 350 *h.p. Hispano-Suiza* 9*Qd nine-cylinder radial air-cooled engine.* **Armament:** *One rearward-firing* 7.5-*mm. Darne machine gun.* **Performance:** *Maximum speed,* 121 *m.p.h. at sea level,* 135 *m.p.h. at* 6,560 *ft.; time to* 6,560 *ft.,* 7 *min.* 15 *sec., to* 9,840 *ft.,* 12 *min.* 15 *sec.; service ceiling,* 18,040 *ft.; endurance at* 81 *m.p.h.,* 5 *hr.* 10 *min.* **Weights:** *Empty,* 2,429 *lb.; loaded* (*catapult launching*), 3,571 *lb.,* (*water take-off*), 3,858 *lb.* **Dimensions:** *Span,* 42 *ft.* 7⅛ *in.; length,* 33 *ft.* 6¾ *in.; height,* 11 *ft.* 1⅞ *in.; wing area,* 261.563 *sq. ft.*

The Potez 452 *flying boat prototype with the port wing folded.*

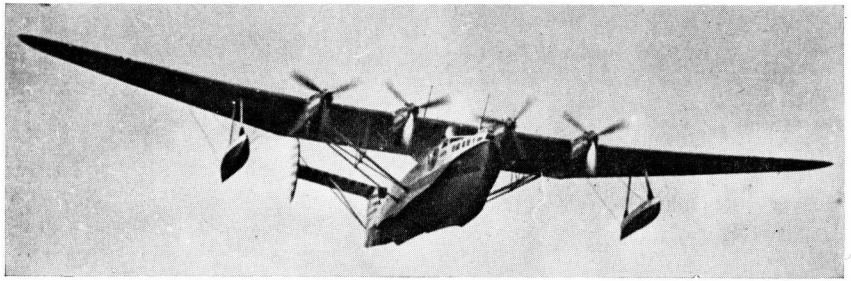


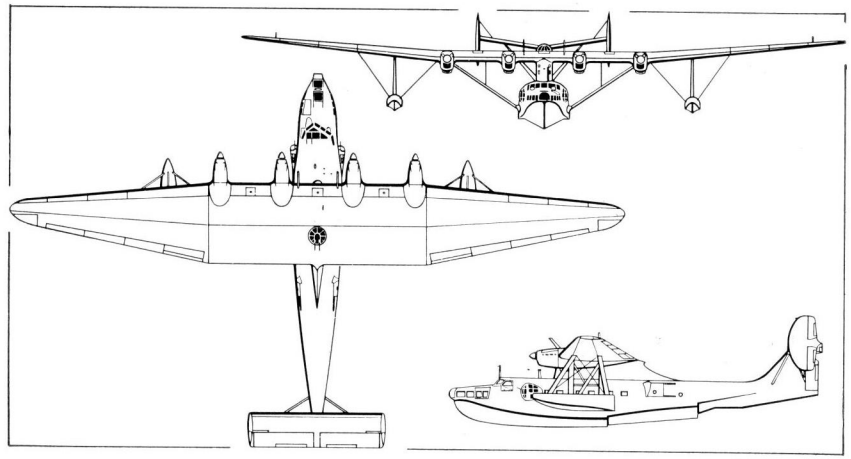
POTEZ-C.A.M.S.141 FRANCE

Like the Breguet 730 and the Latécoère 611, the Potez-C.A.M.S.141 was designed to meet a French Admiralty specification issued on May 10, 1935, and calling for a flying boat to supplant the Bizerte and other types approaching obsolescence. Detailed design and construction was begun by the Chantiers Aéro-Maritimes de la Seine during the second half of 1936, and the prototype, which had been built at Sartrouville and shipped to Caudebec-en-Caux for assembly, flew for the first time on January 21, 1938. After some twenty hours of flying, the bow side keels were raised to improve hydrodynamic performance at maximum loads, and in August 1938, the Potez-C.A.M.S.141 was flown to St. Raphaël for official trials.

After thirty-three hours flight testing at Saint Raphaël, the 930 h.p. Hispano-Suiza 12Y-26/27 engines using 87 octane fuel were replaced by 970 h.p. H.S. 12Y-36/37 engines using 100 octane fuel, but almost immediately the original engines were re-installed. The Potez-C.A.M.S.141 was, like the other flying boats built to the same specification, intended to mount a 25-mm. cannon in the dorsal turret, although this weapon was never installed. In the spring of 1939, the prototype was christened *Antarès* by the French Navy, and a production order was placed for four machines, this being augmented by an additional order for a further fifteen machines shortly before the beginning of the Second World War. Production of the hulls began at Le Havre, the wings being built at Méaulte. Shortly after hostilities began, unlimited production of the Potez-C.A.M.S.-141 was ordered, a delivery rate of two machines per month being scheduled to commence in June 1940. However, on April 27, 1940, as a result of the low loss-rate of long-range flying boats, the French Admiralty requested that production be limited to thirty-one machines and, in the following month, reduced this to eleven machines.

*The Potez-C.A.M.S.*141 *in service with Escadrille* 4E *of the Vichy Navy.*





The original prototype *Antarès* had been delivered to a new unit, Escadrille E8, forming its only flying equipment, and on November 20, 1939, it was decided to install a power-operated turret housing two 7.5-mm. guns and similar to that used by French motor torpedo boats. The *Antarès* flew long-range patrols over the Atlantic until June 18, 1940. It was subsequently flown to Port Lyautey where it was delivered to Escadrille E8, being passed to Escadrille 6E on August 1, 1940, and to Escadrille 4E at Dakar on September 7, 1940. From November 1942, the *Antarès* resumed patrols over the Central and South Atlantic, and on June 2, 1943, sank a German submarine, U-105, some 35 miles from Dakar. The aircraft was finally scrapped late in 1943 by which time it had logged 1,800 flying hours. No production Potez-C.A.M.S.141 flying boats were completed.

Type: *Long-range Maritime Reconnaissance Flying Boat* (*Crew:* 9-12). **Power Plants:** *Four* 930 *h.p. Hispano-Suiza* 12 *Y*-26/27 *twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Two* 7.5-*mm. Darne machine guns in dorsal turret, two* 7.5-*mm. guns in lateral barbettes, and two* 7.5-*mm. guns in waist positions, plus a* 3,300-*lb. bomb load.* **Performance:** *Maximum speed,* 199 *m.p.h. at* 3,280 *ft.; cruising speed,* 161.5 *m.p.h. at* 3,280 *ft.; service ceiling,* 18,370 *ft.; maximum endurance,* 30 *hr.* **Weights:** *Empty,* 33,069 *lb.; normal loaded,* 50,926 *lb.; maximum loaded,* 57,320 *lb.* **Dimensions:** *Span,* 134 *ft.* 6½ *in.; length,* 79 *ft.* 8¾ *in.; height,* 25 *ft.* 9 *in.; wing area* 1,840.62 *sq. ft.*

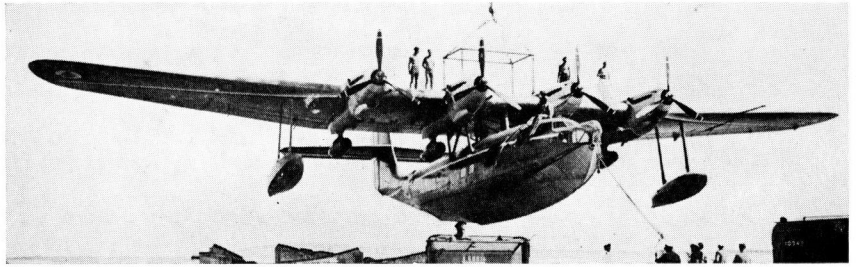
SUD-EST LeO H-246.1 — FRANCE

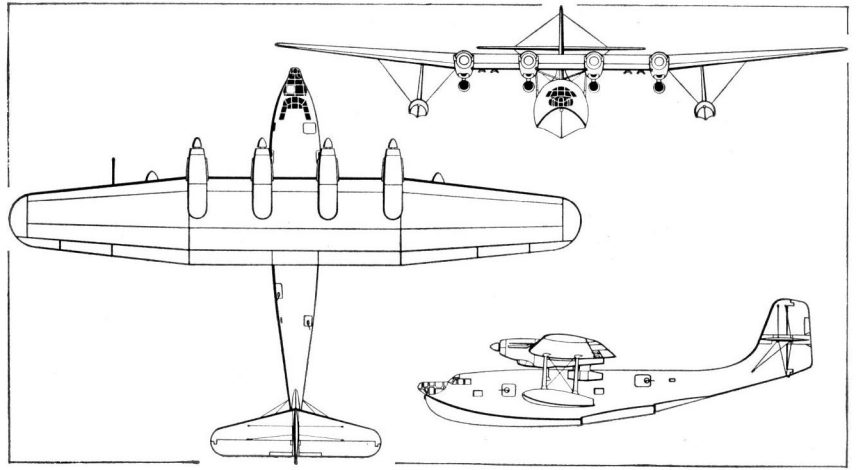
The Lioré-et-Olivier company initiated design work on a twenty-six-passenger commercial flying boat for use on Mediterranean services in 1935 to meet the requirements of an official specification issued on February 27th of that year. Of mixed construction and powered by four Hispano-Suiza 12Xirsl/Xjrsl engines, the flying boat was designated LeO H-246.1, and the prototype was flown from Berre on September 30, 1937.

Flight trials with the LeO H-246 had not been completed when, on January 31, 1938, Air France signed a contract for six flying boats of this type. The manufacturer's prototype trials had been completed by the end of March 1938, and the prototype was flown to Saint Raphaël for official trials. However, during rough-water tials on April 29th, the hull of the LeO H-246 was severely damaged. The hull was subsequently strengthened and official trials were completed in January 1939, at which time five machines were on the production line. As the Lioré-et-Olivier company had been nationalised, the hulls of the production LeO H-246.1 were built at the Vitrolles plant of the S.N.C.A. du Sud-Est, and the first production machine was registered F-AREI, the original prototype, registered F-AOUJ, being brought up to production standards and about to enter service on the Marignane-Algiers route at the beginning of the Second World War.

The French Navy immediately prepared plans to impress the six production LeO H-246 flying boats and equip Escadrille 10E with these. However, Air France still needed the aircraft, and on October 18, 1939, the Navy reduced its demand to four of the flying boats. The second production LeO H-246.1, F-AREJ, was completed as a commercial transport, but the third machine was modified for maritime reconnaissance, provision being made in the bow for the bombardier-navigator, bomb racks being attached beneath the wing between the engine nacelles, and provision being made for defensive armament. This third production aircraft flew for the first time on June 21, 1940, and a few days later

The third production H-246.1 completed as a maritime reconnaissance aircraft in mid-1940.





was flown to Berre for the armament to be installed. On August 25, 1940, the aircraft was handed over to Escadrille 9E, but it was still at Berre when German forces occupied Vichy France, and its ultimate fate is unknown.

The fourth, fifth and sixth production aircraft (F-AREL, F-AREM and F-AREN respectively) were completed as commercial transports and, together with the second and third aircraft, operated the Marignane-Algiers route until November 8, 1942. At least three of these aircraft were seized by the Luftwaffe at Marignane and flown to Germany, and one aircraft at Algiers at the time of the German occupation resumed commercial operations on the Marignane-Algiers route after the liberation of France.

The following specification relates to the third production LeO H-246.1.

Type: *Maritime Reconnaissance Flying Boat (Crew:* 8). **Power Plants:** *Four* 720 *h.p. Hispano-Suiza* 12*Xgrs*1/*Xhrs*1 *twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four* 7.5-*mm. Darne machine guns on flexible mounts and four* 330-*lb. bombs.* **Performance:** *Maximum speed,* 205 *m.p.h. at* 6,560 *ft. cruising speed,* 161 *m.p.h. at* 6,560 *ft.; time to* 11,480 *ft.,* 15 *min.; service ceiling,* 22,965 *ft.; range,* 1,240 *mls.* **Weights:** *Empty,* 19,842 *lb.; loaded,* 33,070 *lb.* **Dimensions:** *Span,* 104 *ft.* 0½ *in.; length,* 71 *ft.* 2¾ *in.; height,* 23 *ft.* 10¼ *in.; wing area,* 1,410 *sq. ft.*

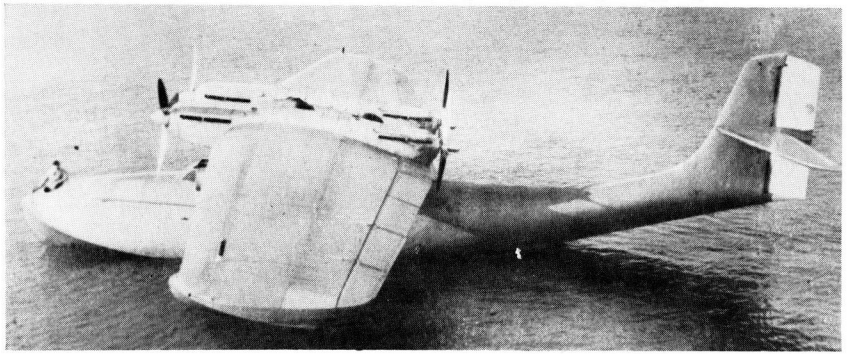
SUD-EST LeO H-470 FRANCE

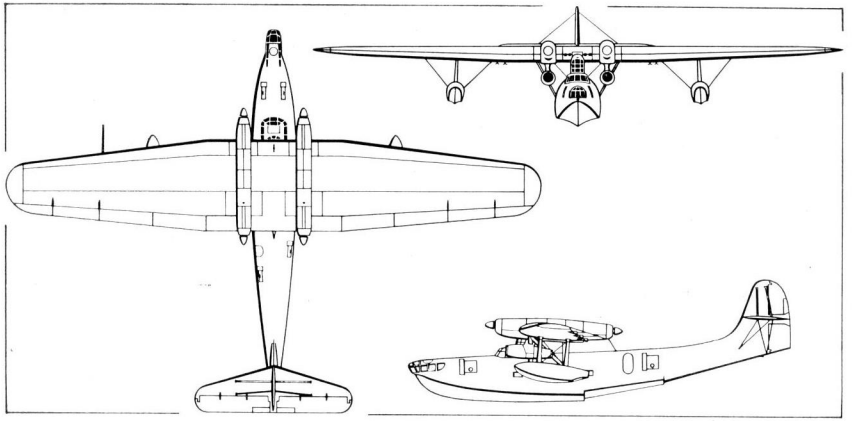
One of the fastest flying boats of the 'thirties resulted from a specification for a commercial flying boat suitable for use over the South Atlantic on the Dakar-Natal route issued by the Ministère de l'Air in 1934. The specification demanded a cruising speed of 155 m.p.h. at 13,450 ft. at two-thirds power, and a 1,865-mile range with a 2,200-lb. payload against a 30 m.p.h. headwind. Among several projects submitted to fulfil these requirements was the LeO H-47 tendered by Lioré-et-Olivier, a prototype of which was ordered on August 10, 1935.

Exceptional care was taken to obtain a high standard of aerodynamic efficiency, and a team headed by M. Benoit was responsible for the design of the hull, and a second team headed by M. Mercier was responsible for the engine installation and wings. The prototype was built at Argenteuil and the components transported to Antibes for assembly, the first flight being effected on July 25, 1936. The LeO H-47 was of all-metal construction and powered by four 880 h.p. Hispano-Suiza 12Y drs 1/frs 1 engines mounted in tandem pairs, and apart from the replacement of the Hamilton Standard airscrews by Ratier units, few modifications had been necessitated by the time manufacturers' trials were completed on January 21, 1937.

These trials had proved particularly successful, the requirements of the specification being exceeded in every respect. At a loaded weight of 40,785 lb., the LeO H-47 had flown at 186 m.p.h. at seventy-five per cent power, and at maximum rated power speed was 224 m.p.h. Maximum range was 2,485 miles. On March 1, 1937, Air France placed an order for five machines, and the Navy began to evince interest in the possibility of adapting the flying

The LeO H-47, illustrated below in its original form, was the prototype of the H-470.



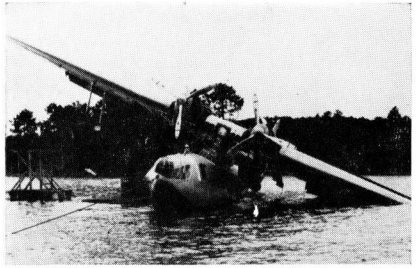


boat for the long-range maritime reconnaissance role. Unfortunately, the trouble-free development augured by the initial trials terminated on May 19, 1937, when the hull bottom sustained a fatigue failure during take-off and, on landing at Antibes at 41,890 lb., took in water which displaced the c.g., and the flying boat sank.

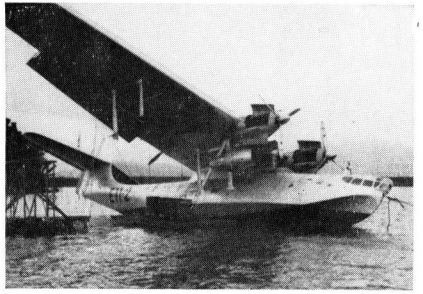
Despite this accident, Air France did not cancel its order, and production was undertaken at the Vitrolles plant of the S.N.C.A.du Sud-Est. The production model, which was designated H-470, differed from the prototype in having a strengthened hull, modified vertical tail surfaces and fuselage-wing bracing, a lengthened hull, increased fuel capacity, and underslung thrust augmentation radiator-exhaust pods. The first LeO H-470 flew at Vitrolles on July 23, 1938, and after manufacturers' trials, was delivered to Saint Raphaël for official tests. At the beginning of the war, the first H-470 was undergoing Air France endurance trials, but none of the other production machines had been delivered, and the Navy immediately requested permission to impress all five machines.

This permission was given and Sud-Est began work at Vitrolles to convert the five aircraft as long-range maritime reconnaissance aircraft. An extended transparent section was inserted in the bow to provide accommodation for the navigator-bombardier, mountings for 7.5-mm. Darne machine guns were introduced, and four bomb racks for 330-lb. bombs were attached beneath the wing. The first and fourth H-470s were delivered to Escadrille E11 at Berre on December 4, 1939, the second production machine following four days later,

but this was written off on December 10th when the pilot alighted by error in shallow water in Lake Urbino, Corsica. The remaining two machines had been delivered by February 15, 1940, and Escadrille E11 was transferred from Berre to Biscarosse. On April 24th, the unit returned to Berre and undertook patrol duties over the Mediterranean until June 25th. On August 1, 1940, Escadrille E11 was re-designated 11E and operated its H-470 flying boats for communications and transport duties between Vichy France and Tunisia. Nine days later, one of the H-470s was mistaken for a British flying boat by Italian fighters and shot down off Sardinia, and on August 15th Escadrille 11E was disbanded, the three surviving H-470s subsequently being handed to Escadrille 9E based at Berre. In June 1941 they were transferred to Dakar where one of them participated in experiments in afloat refuelling, acting as a tanker to Laté 298 floatplanes of Escadrille 6T. The occupation of Vichy France deprived the H-470s of their supply of spares, and the last flying boat of this type was scrapped in August 1943, the H-470s having operated briefly from Dakar in protection of Allied shipping.



The second production H-470 seen in December 1939 after its pilot had alighted in shallow water in Lake Urbino, Corsica, the aircraft being too badly damaged to permit repairs. The last H-470 acquired by the French Navy was scrapped in August 1943 owing to a shortage of spares.



Type: *Long-range Maritime Reconnaissance Flying Boat (Crew: 9).* **Power Plants:** *Four 880 h.p. Hispano-Suiza 12Y-34/35 twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Four 7.5-mm. Darne machine guns on flexible mountings and four 330-lb. bombs.* **Performance:** *Maximum speed, 211 m.p.h. at 3,280 ft., 219 m.p.h. at 6,560 ft.; range (with 1,870 Imp. gal. of fuel), 2,188 mls. at 109 m.p.h. at 1,640 ft., 1,670 mls. at 144 m.p.h. at 1,640 ft., 2,303 mls. at 132 m.p.h. at 8,200 ft., 1,670 mls. at 173 m.p.h. at 8,200 ft., (with 2,100 Imp. gal.), 2,650 mls. at 132 m.p.h. at 8,200 ft.; time to 6,560 ft., 8 min. 15 sec.* **Weights:** *Empty, 23,148 lb.; normal loaded, 43,652 lb.; maximum, 44,533 lb.* **Dimensions:** *Span, 104 ft. 3⅞ in.; length, 71 ft. 3¼ in.; height, 23 ft. 5½ in.; wing area, 1,453.13 sq. ft.*

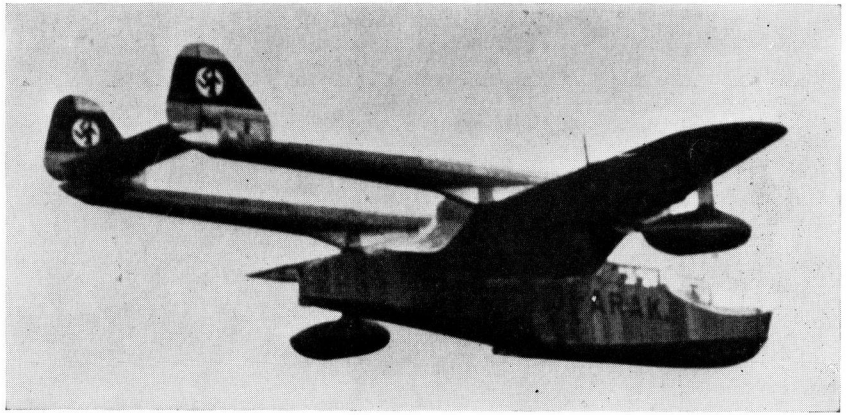
BLOHM UND VOSS BV 138

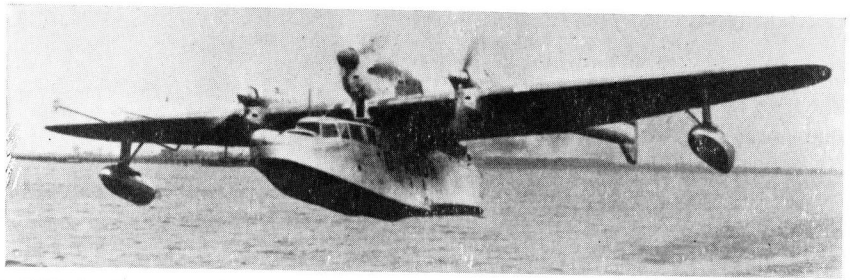
GERMANY

In 1933, the Blohm und Voss shipyards at Hamburg opened an aircraft department under the name of Hamburger Flugzeugbau, and one of the first projects to be studied was a long-range reconnaissance flying boat. A variety of configurations with two, three and four engines were studied, that finally selected being the Projekt 12 featuring an abbreviated central hull with twin booms supporting the tail assembly, power being provided by two Junkers Jumo 206 diesel engines. Work on a mock-up began on March 6, 1935, and an initial order was placed for three prototypes under the designation Ha 138. The three prototypes were to have been powered respectively by BMW 15, Jumo 206 and DB 600 engines, but as design work progressed, both the BMW 15 and the Jumo 206 engines were abandoned by their manu acturers, and as it appeared unlikely that the DB 600 would be available for installation, the Ha 138 was re-designed to take three Jumo 205C engines.

Twenty-seven months after the commencement of construction, the Ha 138VI was flown for the first time, this event taking place on July 15, 1937. The second prototype, which embodied a number of changes to the hull, was completed during the following month and, after manufacturer's trials, was flown to the test centre at Travemünde on November

The first Blohm und Voss Ha 138 prototype which flew initially on July 15, 1937.

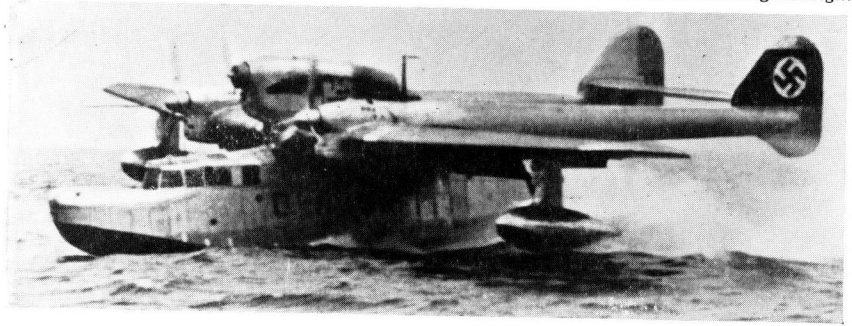




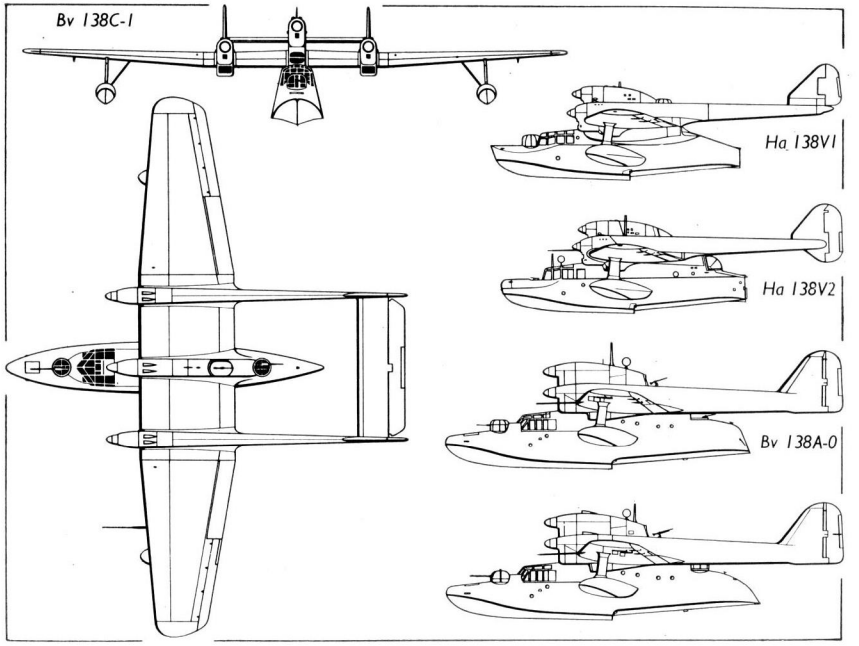
6, 1937. Inadequate stability in flight displayed by the Ha 138V2 necessitated redesign of the vertical tail surfaces, and rough-water trials revealed the need for extensive reinforcement of the hull. In addition, it was found that the Ha 138 had poor hydrodynamic characteristics, and it was decided to abandon work on the third prototype and undertake a complete redesign of the flying boat, merely retaining the basic configuration.

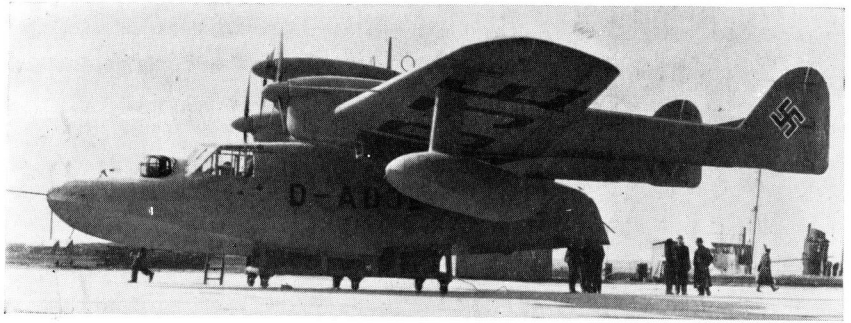
Redesign was undertaken during 1938, and by the time the first of the redesigned flying boats flew in February 1939, the name Hamburger Flugzeugbau had been dropped, the third aircraft, in fact the first of six pre-production machines, thus being designated

(Above and below) The Ha 138V2 offered poor hydrodynamic characteristics necessitating redesign.

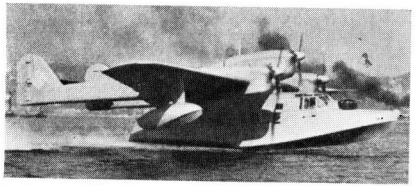


Bv 138A-01. The Bv 138A-0 differed from the Ha 138 principally in having an entirely new and very much larger hull, the gull centre section of the wing eliminated, the oval-section tail booms replaced by rectangular-section booms, and larger vertical tail surfaces. Armament comprised a bow turret in which it was proposed to install a 20-mm. MG 204 cannon (this cannon was eventually abandoned owing to prolonged teething troubles), a single 7.9-mm. MG 15 machine gun in an open position immediately aft of the central engine nacelle, and a similar weapon in an open position in the tail of the hull. During evaluation this armament proved to be entirely unsatisfactory. The bow turret was particu-





(Above and below, left) The Bv 138A-01 (D-ADJE) differed extensively from the Ha 138V1 and V2, the gull wing centre section being eliminated and the hull being substantially enlarged.



larly troublesome and was eventually removed and replaced by an open position with a single 7.9-mm. MG 15 gun.

The first production order called for twenty-five By 138A-1 reconnaissance flying boats, and the first of these was flown in April 1940. Owing to the acute shortage of seaplanes experienced by the Luftwaffe during the invasion of Norway, the first and second Bv 138A-1s were immediately pressed into service during the campaign as transports. The first unit to re-equip with the Bv 138A-1 for the long-range reconnaissance role became operational in western France in October-November, 1940, but early experience with the flying boat on operations revealed the need for structural strengthening. The fourth pre-production Bv 138A-0 had been completed as the Bv 138B-0, and a batch of fourteen Bv 138B-1 boats had followed the A-1 on the assembly line. The structural strengthening found necessary with the Bv 138A-1 on operations was incorporated in these aircraft which were delivered in December 1940 to take the place of the unsatisfactory Bv 138A-1s.

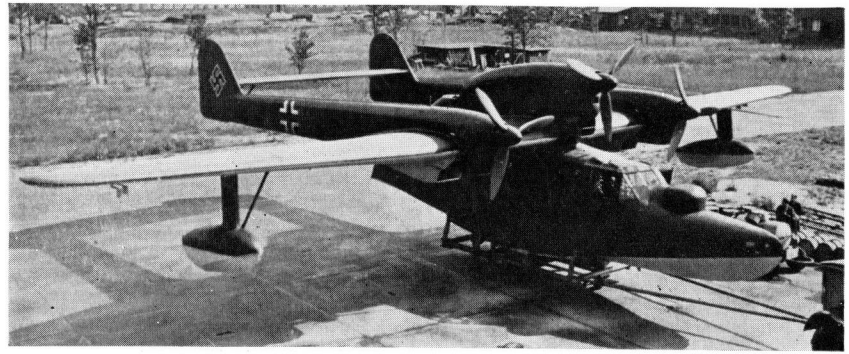
The Bv 138B-1 differed from the A-1 and the few B-0 aircraft produced by converting pre-production A-0s in having improved defensive armament. A new powered turret containing a single 20-mm. MG 151 cannon was installed in the bow, and a similar turret was installed in the tail of the hull. All existing By 138B-0 flying boats, most of the Bv 138A-1s and three Bv 138A-0s were subsequently fitted with similar armament. A total of twenty-one Bv 138B-1 boats were built, fourteen being

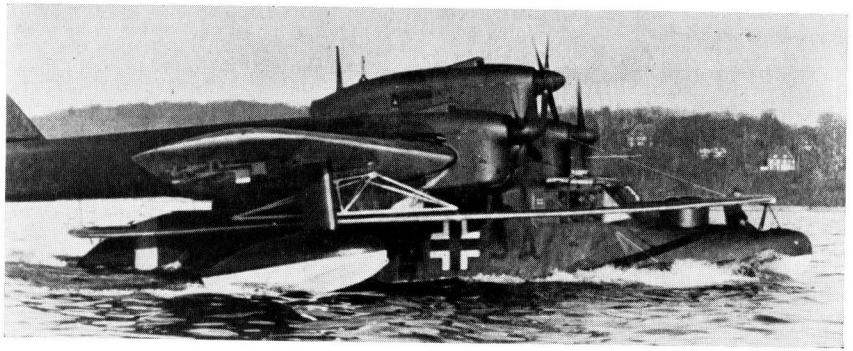
completed in 1940 and seven in 1941. These were powered by three 880 h.p. Jumo 205D engines and the offensive load comprised three 110-lb. bombs on racks beneath the centre section of the starboard wing. The offensive load could be increased to six 110-lb. bombs or four 330-lb. depth charges (Bv 138B-1/U1), but these heavier loads were rarely carried on operations.

During the winter of 1940-41, the sole Bv 138B-equipped unit was grounded owing to troubles with the airscrews and engines, and the opportunity was taken to carry out further structural strengthening. The unit became operational again in June 1941, and in the following month was based in Norway, undertaking shipping reconnaissance missions over the North Sea and into the Atlantic. During October 1941, one staffel with ten Bv 138B-1s flew more than 62,000 miles, although no more than a dozen flying boats of this type were in service simultaneously throughout the year. During the autumn of 1941, a Blenheim was destroyed by a Bv 138B over the Skaggerak, and another destroyed a Catalina. One Bv 138B shadowing a British convoy escorted by a carrier was attacked continuously for ninety minutes by fighters but succeeded in returning to base. Three Bv 138B-1s were lost in action during the year.

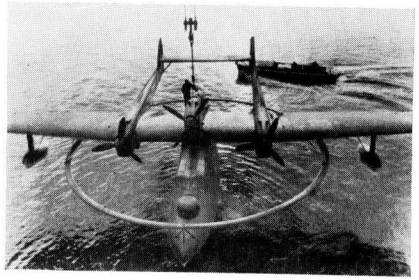
The test flying and delivery of Bv 138s was seriously interrupted during the early months of 1941 owing to being ice-bound on the River Elbe, but in March the improved Bv 138C-1 began to leave the assembly line. Extremely high priority was given to the production of the Bv 138C-1 by the R.L.M., and Weserflugzeugbau joined the manufacturing programme (although, in the event, this concern succeeded in producing only one machine during 1941, and the major components for this had been manufactured by Blohm und Voss). Despite

The fourth pre-production aircraft (below) was completed as the By 138B-0.





(Above and below, left) A number of Bv 138*B-0 aircraft were converted for mine-sweeping.*

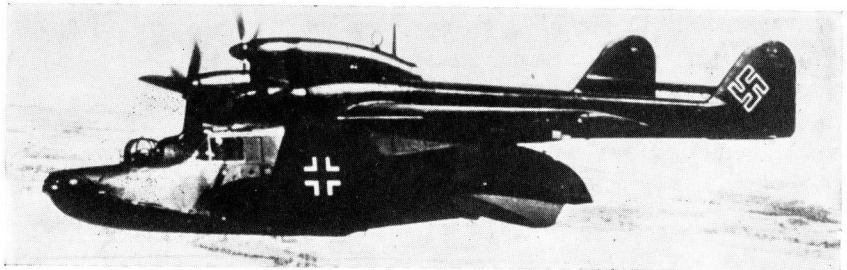


the high priority, however, delays in the deliveries of turrets, engines and radio equipment kept production to a trickle, and only seventy-two Bv 138C-1 boats were completed in 1941, eighty-five being produced in 1942, and seventy were completed in 1943 when further production was abandoned.

The Bv 138C-1 differed little externally from the B-1 apart from a modified radiator and a four-blade airscrew for the centre engine (changes later made on the B-1), the introduction of broad-bladed airscrews for the outer engines, and the provision of a 13-mm. MG 131 machine gun for the upper position. Some machines were fitted with a 7.9-mm. MG 15 machine gun which was fired from a hatch in the starboard side of the hull by the radio operator. The C-1 had three bomb racks under the starboard wing centre section, but the C-1/U1 had six bomb racks in this position.

A few Bv 138B-0 aircraft were converted for mine-sweeping. Designated Bv 138MS, these aircraft were fitted with a dural hoop energized by an auxiliary motor. No gun turrets were fitted.

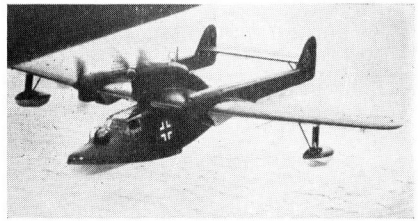
Once the initial teething troubles had been overcome, the Bv 138 proved a successful operational aircraft. Although reinforcement



The principal production variant, the Bv 138*C-1 featured modified armament and equipment.*

of the hull, flaps and outrigger floats was undertaken progressively during its career, it was an exceptionally sturdy machine, capable of withstanding a considerable amount of punishment. All versions of the flying boat could be fitted with two 1,100-lb. thrust take-off rockets, and seventy aircraft were modified to suit them for catapult take-off. In the transport role, the Bv 138 carried a maximum of ten passengers, and for anti-shipping operations in co-operation with long-range bombers and submarines, a number of Bv 138C-1s were fitted with FuG 200 *Hohentwiel* search radar.

The following specification relates to the Bv 138C-1, figures for the Bv 138B-1 being quoted in parentheses.



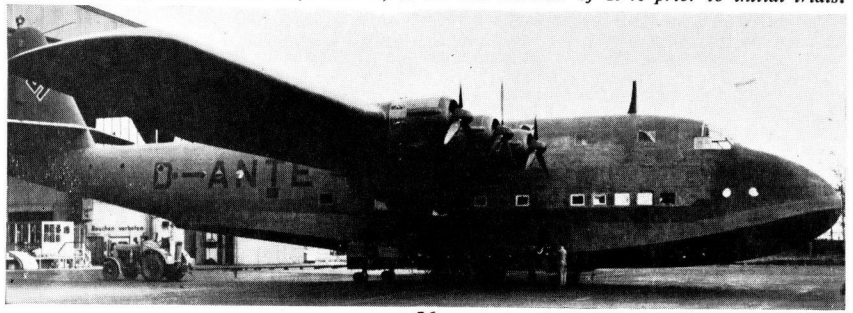
Type: *Long-range Maritime Reconnaissance Flying Boat.* **Power Plants:** *Three* 880 *h.p. Junkers Jumo* 205*D twelve-cylinder vertically-opposed diesel engines.* **Armament:** *One* 20-*mm. MG* 151 *cannon in each of bow and rear hull turrets, one* 13-*mm. MG* 131 *machine gun in open position aft of central engine nacelle, and one* 7.9 *mm. MG* 15 *gun firing through hatch in starboard side of hull, plus three* 110-*lb. bombs or* (*B-*1/*U*1 *and C-*1/*U*1) *six* 110-*lb. bombs or four* 330-*lb. depth charges.* **Performance:** *Maximum speed,* 177 (180) *m.p.h.; cruising speed,* 146 (149) *m.p.h.; ceiling at* 31,967 (31,724) *lb.,* 16,400 (13,780) *ft., at* 38,912 (38,361) *lb.,* 9,185 (7,545) *ft.; maximum range,* 2,670 (2,410) *mls.* **Weights:** 25,948 (25,066) *lb.; normal loaded,* 31,967 (31,724) *lb.; maximum permissible,* 38,912 (38,361) *lb.* **Dimensions:** *Span,* 88 *ft.* 4½ *in.; length,* 65 *ft.* 1⅛ *in.; height,* 19 *ft.* 4¼ *in.; wing area,* 1,205.558 *sq. ft.*

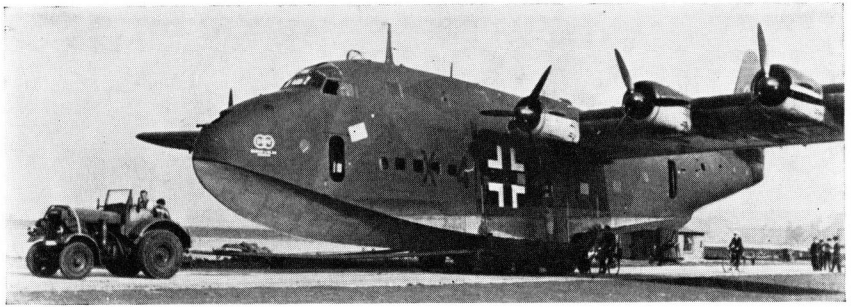
BLOHM UND VOSS BV 222 WIKING — GERMANY

Designed to provide Deutsche Lufthansa with a spacious long-range flying boat for use over both North and South Atlantic routes, the Bv 222 Wiking was the largest seaplane to attain production status during the Second World War. Evolved by a design team headed by Dr. Ing. Richard Vogt, the Bv 222 was intended to operate at an all-up weight of 99,200 lb., with twenty-four day passengers or sixteen passengers by night, and three flying boats of this type were ordered by D.L.H. on September 19, 1937. The first metal for the Bv 222V1 was cut in January 1938, and work on the second and third prototypes had begun before the end of the year. The Bv 222V1, carrying the civil registration D-ANTE, flew on September 7, 1940, with Flugkapitän Helmut Wasa Rodig at the controls. Apart from some slight instability and a tendency to porpoise on the water, the prototype displayed good characteristics, and with the decision to combine long-range trials with genuine freight delivery missions for the Luftwaffe, larger freight doors were fitted to permit crated aero engines to be loaded into the hull. Carrying no defensive armament and flown by a civilian crew, the Bv 222V1 undertook its first mission for the Luftwaffe on July 10, 1941, with a flight between Hamburg and Kirkenes, Norway.

The long-range trials were completed on August 29, 1941, and after a complete overhaul, the Bv 222V1 began flights between Hamburg, Athens and Derna with supplies for the *Afrika Corps*. Despite some minor engine troubles, the boat operated with complete satisfaction. It was usually escorted over the Mediterranean by two Bf 110 fighters, but the need for some form of defensive armament was made obvious on occasions when the Bv 222V1 missed its fighter escort and narrowly eluded patrolling British aircraft. Therefore, during the winter of 1941-42, the Bv 222V1 was flown back to Hamburg and fitted with a

The first Wiking, the Bv 222V1 (D-ANTE) in the late summer of 1940 prior to initial trials.

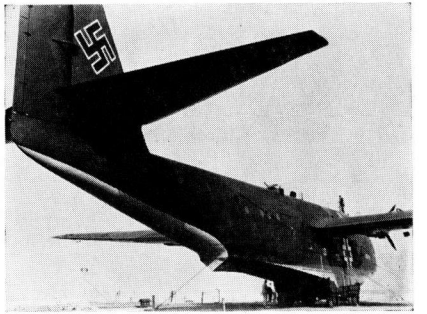




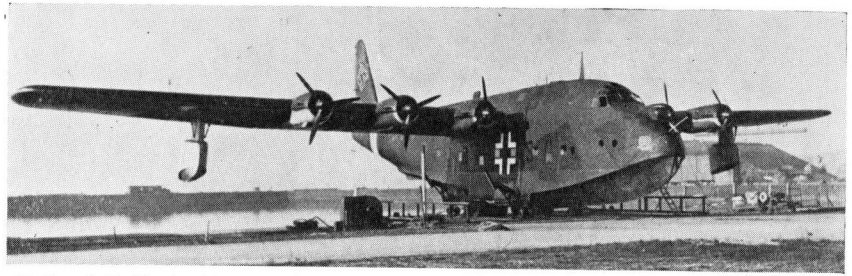
(Above and below, right) The Bv 222V1 after modifications for use by Lufttransportstaffel See 222.

flexible 7.9-mm. MG 81 machine gun in the nose, two upper turrets each housing a 13-mm. MG 131 machine gun, and four additional MG 81s firing from positions in the hull waist. Armed in this fashion, the Bv 222V1 was handed over to the Luftwaffe on May 10, 1942, and delivered to *Lufttransportstaffel See* 222. In its unarmed form, the Bv 222V1 had attained a maximum speed of 239 m.p.h. at 14,765 ft., and maximum range had been 4,350 miles, but by July 1942 this had been increased to 5,655 miles. As a troop transport the Bv 222V1 could accommodate ninety-two fully-equipped troops, and in the casualty transport role could accommodate seventy-two litter cases.

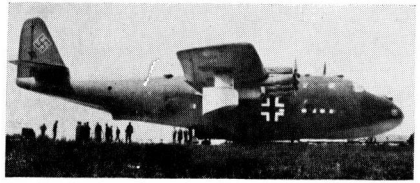
The second prototype, the Bv 222V2, had flown for the first time on August 7, 1941, and as it was proposed that this machine should be operated by the *Fliegerführer Atlantik*, it carried a heavy defensive armament from the outset. This was similar to the armament installed in the Bv 222V1 apart from the addition of two gondolas under the wing centre



section which each housed two 13-mm. MG 131 machine guns. After initial trials at Travemünde it was decided to remove the underwing gondolas owing to the marked effect that their drag had on performance. The rear fuselage and outer wing panels were strengthened,



(Below, left) The Bv 222V2 and (above) V3 were similar and were operated by LTS See 222



the keel was deepened, and auxiliary steps were added to the planing bottom. After the completion of these modifications, the Bv 222V2 was again tested at Travemünde, but instead of going to the *Fliegerführer Atlantik* was delivered to *LTS See* 222 on August 10, 1942.

All the first six prototypes of the Wiking were powered by six BMW/Bramo Fafnir 323R radials offering 1,000 h.p. for take-off, but by the end of 1942 this had been boosted to 1,200 h.p. by means of methanol-water injection. Maximum speed ranged from 214 m.p.h. at sea level to 242 m.p.h. at 16,075 ft. Maximum endurance was thirty-three hours at sea level and twenty-three hours at 16,075 ft. ,an altitude of 19,685 ft. was attained in forty-nine minutes, and service ceiling was 21,325 feet.

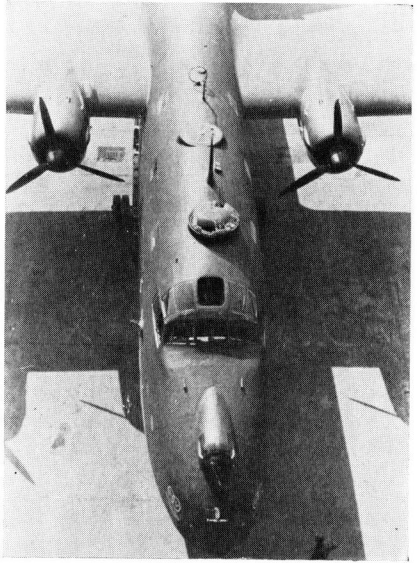
The Bv 222V3, which first flew on November 28, 1941, was similar to its immediate predecessor and was delivered to *LTS See* 222 on December 9, 1942, after having undertaken a series of supply flights between Italy and Tripoli. Although the Bv 222V3 was originally to have had a similar defensive armament to that of the V2, it was delivered with only one gun position, the MG 81 being retained in the bow, all other positions being faired over. On February 5, 1943, the installation of more extensive defensive armament was ordered. The bow gun position was deleted and a power-operated turret housing a 20-mm. MG 151 cannon was installed immediately aft of the flight deck. Two similar turrets were mounted in the wings between the outboard engine nacelles, and two dorsal turrets housed two 7.9-mm. MG 81 machine guns and one 13-mm. MG 131 machine gun respectively. FuG 200 *Hohentwiel* search radar was installed together with FuG 216R Neptun for rear warning. After these modifications, maximum speed at 99,210 lb. was reduced to 183

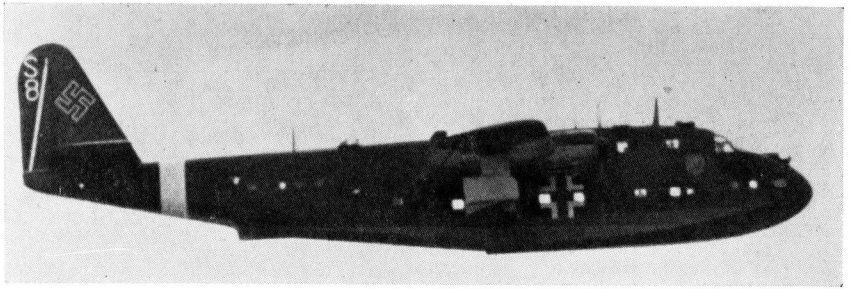
m.p.h. and economical cruising speed was 156.5 m.p.h. At 88,185 lb. maximum speed was 188 m.p.h. The conversion of the Bv 222V3 was undertaken in the D.L.H. workshops at Travemünde, and in March 1943 it was decided to convert the Bv 222V2 and V4 at Travemünde, and the Bv 222V5 at Hamburg, all four aircraft being intended to undertake long-range maritime reconnaissance missions.

At this time, seven prototypes had been completed, the Bv 222V1–6 inclusive and the Bv 222V8, and all had served with *LTS See* 222, three having been lost during operations in the Mediterranean. The first to be destroyed had been the Bv 222V6 which had been shot down on November 24, 1942, during an unescorted flight between Taranto and Tripoli. The Bv 222V8 was lost on December 10, 1942 when, on a similar flight in company with the Bv 222V1 and V4, it was shot down by three Beaufighters, and the Bv 222V1 hit a buoy during a landing at Athens in February 1943, and sank immediately. After conversion for maritime reconnaissance, the four surviving Bv 222s finally came under the command of the *Fliegerführer Atlantik*, but the V3 and V5 were destroyed at their moorings at Biscarosse by strafing Allied fighters in June 1943, leaving the V2 and V4, one of which destroyed a Lancaster over the Atlantic in October 1943.

In Luftwaffe service the Fafnir 323R-powered prototypes had been designated Bv 222A, the Bv 222B being a proposed commercial version powered by the Junkers Jumo 208 diesel engine which failed to materialise, and the first production model was the Bv 222C, the prototype for which was the Bv 222V7. Flown for the first time on April 1, 1943, the Bv 222V7 was powered by six 1,000 h.p. Junkers Jumo 207C engines. Armament comprised three 20-mm. MG 151 cannon in power-operated turrets (immediately aft of the flight deck and between the outboard engine nacelles) and five 13-mm. MG 131 machine guns (one in the bow and four in the hull waist). The Bv 222V7 had an empty weight of 67,572 lb. and a normal loaded weight of 100,530 lb., but with the aid of take-off assistance rockets, this prototype could have an overload weight of 114,640 lb. The Bv 222V7 was equipped with FuG 200 search

The Bv 222V4 (below) survived until the end of hostilities, eventually being sunk by its crew.

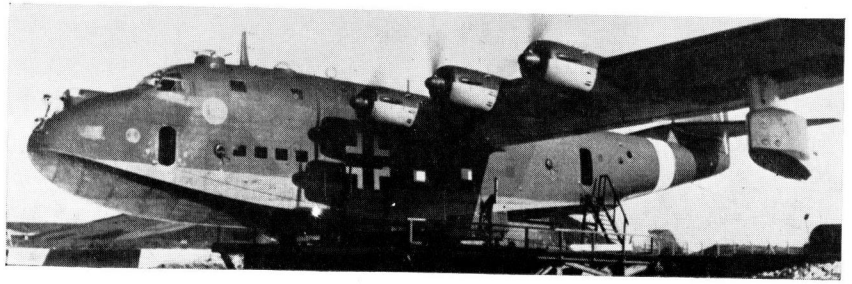


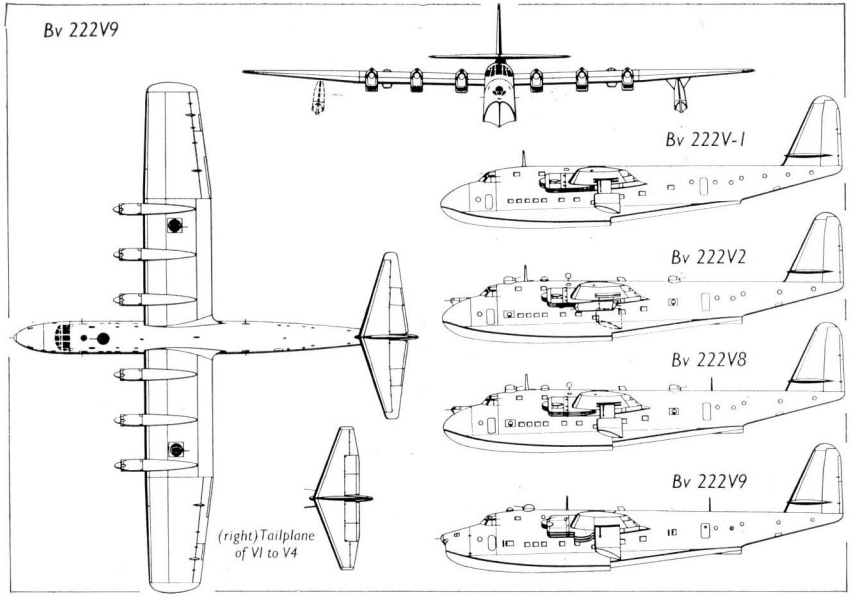


radar and was delivered on August 16, 1943, for maritime reconnaissance tasks.

The V7 had been preceded into service by the first genuine production Wiking which was known both as the Bv 222V9 and as the Bv 222C-09. This had been delivered on July 23, 1943, and the Bv 222C-010, -011 and -012 were similar. The thirteenth Wiking was to have been fitted with Jumo 205D engines as the first Bv 222D, and this aircraft was under construction in mid-1943, but the decision to terminate further work on the Jumo diesel engines presented Blohm und Voss with a power plant problem, and the projected D-series was abandoned. Consideration was given to the use of four BMW 801 radials, but availability necessitated the decision to rever to the Fafnir 323R with the twentieth Wiking

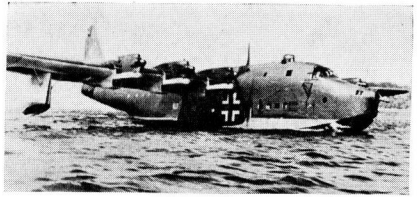
(Above and below) The Bv 222V8, the last genuine Versuch machines, lost on December 10, 1942.



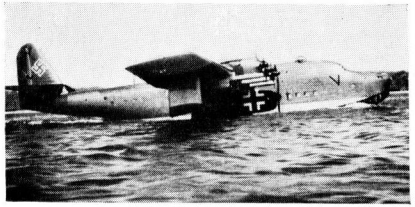


which was to become the first Bv 222E, this featuring blister-type waist gun positions. When further work on the Bv 222 was abandoned in 1944 owing to the need to conserve strategic materials for the production of fighters and bombers, the Bv 222C-014, -015, -016, and -017 were under construction, but the Bv 222C-013 was the last boat to be completed, Jumo 205C engines having been fitted.

The four production Bv 222C-0 flying boats had been delivered to the Luftwaffe during 1943, and the Bv 222C-010 was shot down by British night fighters near Biscarosse during the following year. Of the remaining Wiking boats, the Bv 222V2 was destroyed by British troops in Norway and the C-09 was damaged beyond repair at Travemünde by strafing Mustangs. The Bv 222V4 and V7 were destroyed by their crews at Kiel-Holtenau and Travemünde, the C-011 and C-013 were taken to the



(*Above and below*) *The Jumo-powered Bv* 222*V*7.

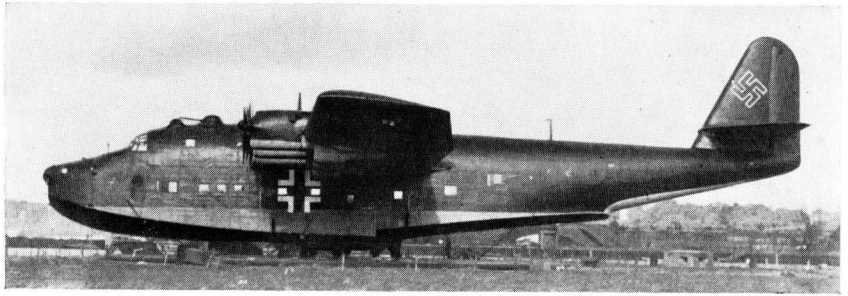


U.S.A., and the C-012 was eventually ferried to the U.K.

The following specification relates to the Bv 222C.

Type: *Long-range Maritime Reconnaissance and Transport Flying Boat* (*Crew:* 11-14). **Power Plants:** *Six* 1,000 *h.p. Junkers Jumo* 207*C twelve-cylinder vertically-opposed diesel engines.* **Armament:** *One* 13-*mm. MG* 131 *machine gun in bow, one* 20-*mm. MG* 151 *cannon in forward dorsal turret and two wing turrets, and four* 13-*mm. MG* 131 *or* 7.9-*mm. MG* 81 *machine guns on lateral mountings in cabin windows.* **Performance:** *Maximum speed,* 205 *m.p.h. at sea level,* 242 *m.p.h. at* 16,400 *ft.; economical cruising speed,* 189 *m.p.h. at sea level,* 214 *m.p.h. at* 18,210 *ft.; initial climb rate,* 473 *ft./min.; time to* 19,700 *ft.,* 52 *min.; maximum range,* 3,790 *mls. at* 152 *m.p.h.; maximum endurance,* 28 *hr.* **Weights:** *Empty,* 67,572 *lb.; normal loaded,* 100,503 *lb.; maximum,* 108,030 *lb.* **Dimensions:** *Span,* 150 *ft.* 11 *in.; length,* 121 *ft.* 4⅜ *in.; height,* 35 *ft.* 9⅛ *in.; wing area* 2,744.8 *sq. ft.*

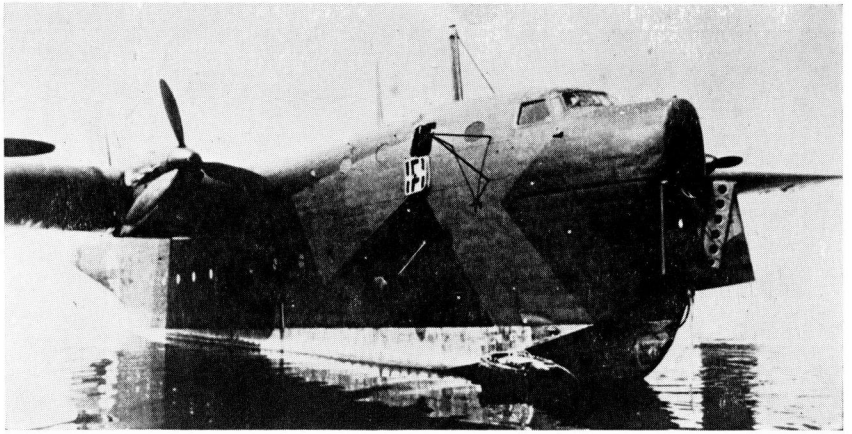
The first genuine production Wiking, the Bv 222*C*-09, *or Bv* 222*V*9, *which was delivered in July,* 1943.



BLOHM UND VOSS BV 238 — GERMANY

In January 1941, Blohm und Voss received instructions from the R.L.M. to prepare a project for an extremely large multi-purpose flying boat powered by four 2,500 h.p. Junkers Jumo 223 diesel engines. Envisaged as an ultimate replacement for the Bv.138, the project was allocated the designation Bv 238, and within a month the basic layout had been submitted to the R.L.M. As originally submitted, the Bv 238 had empty and loaded weights of 84,437 lb. and 123,460 lb. respectively, and a maximum permissible take-off weight of 164,244 lb. Wing span and area were 173 ft. 10⅜ in. and 2,002 sq. ft., and overall length was 130 ft. 1 in. At normal loaded weight it was estimated that the flying boat would attain maximum speeds of 214 m.p.h. at sea level and 248 m.p.h. at 19,685 ft., maximum range being 3,045 mls. at 236 m.p.h. at 13,120 ft. At maximum loaded weight, range was expected to be 5,840 mls. at 202 m.p.h.

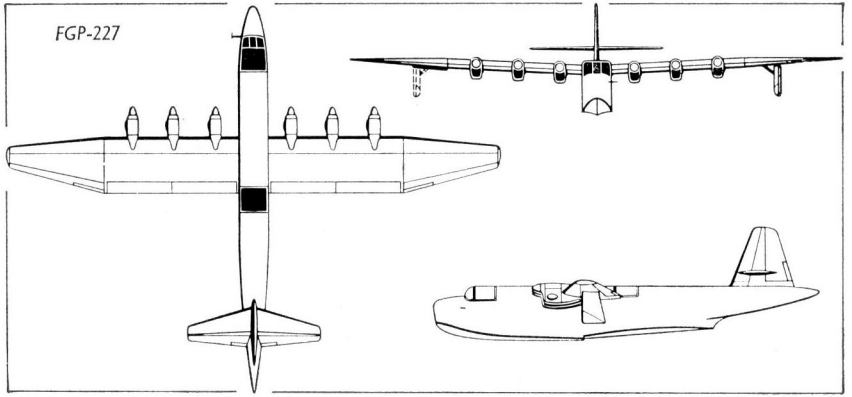
In July 1941, it became obvious that Junkers would be unable to bring the Jumo 223 engine to production status for several years, and Blohm und Voss were forced, therefore, to abandon the original Bv 238 project and produce an entirely new design. Of similar basic concept to the earlier Bv 222, the second Bv 238 proposal was for a large six-engined aircraft of orthodox configuration powered by either the Daimler-Benz DB 603 liquid-cooled engine or the BMW 801 air-cooled radial. A development order was promptly placed to cover the construction of four prototypes, the

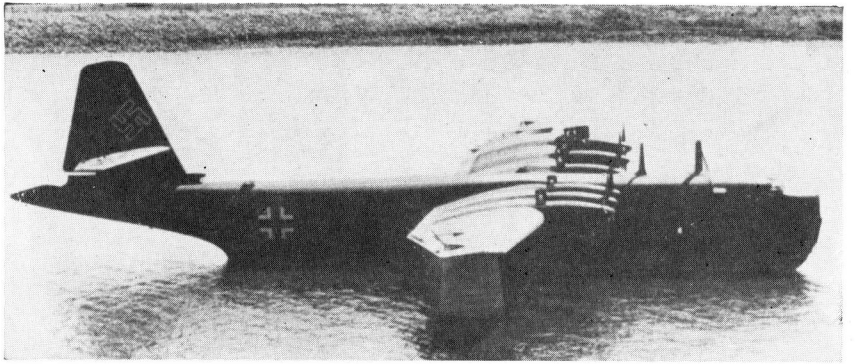


first three of these, the Bv 238V1, V2 and V3, having the liquid-cooled engines and serving as prototypes for the Bv 238A production model, and the Bv 238V4 having the air-cooled radials as a prototype for the proposed Bv 238B.

The design of the Bv 238 incorporated the latest German hydrodynamic discoveries, and in order to gain some idea of the handling characteristics of the boat, it was decided to build a flying scale model to approximately quarter-scale. The construction of this model was entrusted to the Fluttechnische Fertigungsemeinschaft Prag, a small factory in the vicinity of Prague which had some experience of wooden glider manufacture. Work on the model, which was designated FG-227, began in 1942. The aircraft was of wooden construction and powered by six 21 h.p. ILO F 12/400 two-stroke engines. It was anticipated that construction of the model would be completed within twelve months but, in the event, it was not until early 1944 that the FG-227 was ready for testing. While being loaded aboard a train which was to transport it to Travemünde the model was sabotaged, and the damage was not repaired until September 1944. On its first test flight a fault in the fuel supply resulted in the stoppage of all six engines, and further damage was sustained when the machine was forced to alight on the sea. Thus, the FG-227 played little part in the development of the full-scale Bv 238.

Work on prototype construction had begun with the receipt of the development order from the R.L.M., and owing to Blohm und Voss's limited design capacity, a second design bureau for Bv 238 development was established in Paris, and the Weserflug concern was also instructed to participate in the design pro-

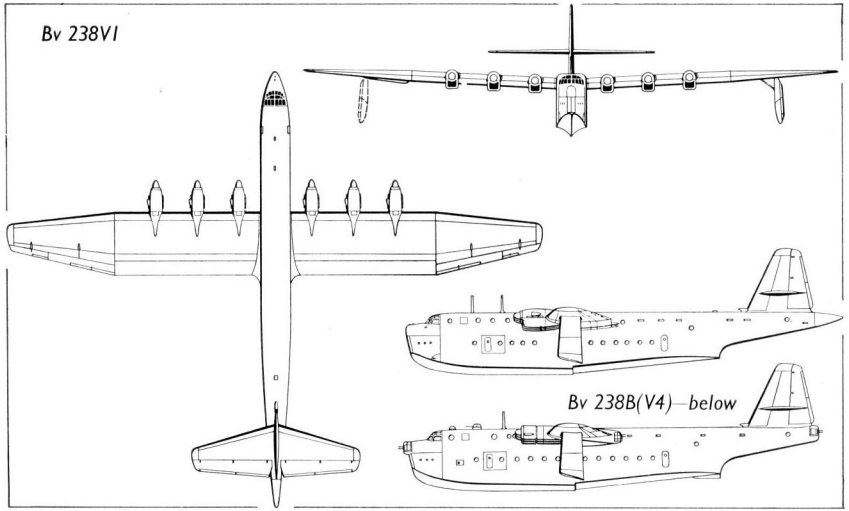




The Bv 238V1 was destroyed in a strafing attack on Lake Schaal by Mustangs of the U.S.A.A.F

gramme. It was intended that the Bv 238 would be used for the long-range reconnaissance, bomber and armed transport roles. The reconnaissance and bomber variants were to have carried a defensive armament of twelve 20-mm. MG 151 cannon in six twin-gun barbettes, most of which were to be remotely-controlled, and the transport version was to have had one barbette immediately aft of the flight deck and another in the tail. The remotely-controlled lateral barbettes were abandoned at an early stage, owing to their weight and complexity, these being supplanted by hand-held 13-mm. MG 131 machine guns or 20-mm. MG 151 cannon firing through sliding panels. In the spring of 1943, further changes in the proposed defensive armament took place, this being standardised as four 13-mm. MG 131 machine guns with 7,200 rounds in a manned nose turret, a similar turret in the tail, twin MG 151 guns with 2,800 rounds in a turret immediately aft of the flight deck, a turret with four MG 131s and 3,600 rounds at the extremities of the wing centre section, and two MG 131s with 1,000 r.p.g. firing through beam windows.

In order to accommodate the wing-mounted four-gun turrets, a special component had to be built into each end of the wing centre section, necessitating the reinforcement of the main spar and an increase in wing span and area from 189 ft. $5\frac{3}{8}$ in. and 3,735 sq. ft. to 197 ft. $4\frac{3}{4}$ in. and 3,928.83 sq. ft., empty weight rising to 120,152 lb. Tank tests indicated that the increased span would result in a reduction in the flying boat's ability to withstand operations from rough water, and further strengthening was undertaken, adding a further 440 lb. to the empty weight. It was planned that the first prototype to feature the full armament and fully strengthened main spar would be the Bv 238V4, the empty weight of which was



calculated at 117,727 lb., this being reduced to 115,963 lb. in the Bv 238V6 by means of a reduction in the hull structural weight. The maximum take-off weight was estimated at 198,420 lb., but it was calculated that take-offs at weights above 176,370 lb. would have to be made with the aid of four 3,330 lb. thrust Jato rockets.

The normal loaded weight for the reconnaissance version (with a total of 5,345 Imp. gal. of fuel) was estimated at 171,960 lb. for open sea take-offs, this being increased to 198,420 lb. (with 7,039 Imp. gal. of fuel) for take-offs from sheltered water. In its bomber form, the Bv 238A was to have normal and maximum loaded weights of 180,780 lb. and 182,980 lb., while those of the Bv 238B were to have been 185,190 lb. and 187,390 lb. respectively. Bomb-bays in the wings were to accommodate twenty 550-lb. SC 250 bombs and six 110-lb. LC 50 flares, and alternative external loads were four 2,645-lb. LD 1200 torpedoes, four 2,200-lb. SC 1000 bombs, two 2,200-lb. Blohm und Voss Bv 143 glide bombs, four Henschel Hs 293 missiles, or two Hs 293s plus two Hs 294 or Hs 295 missiles.

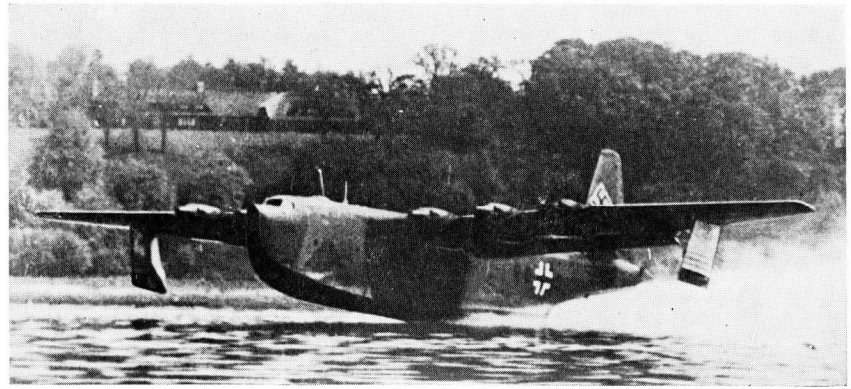
The Bv 238V1 began trials in the early spring of 1944, and it was planned that armament

would be installed after the completion of flight testing, but before this plan could be carried out, the flying boat was destroyed in a strafing attack on Lake Schaal by U.S.A.A.F. Mustangs. The Bv 238V2 was nearing completion at the end of the war, and construction of the Bv 238V3 was well advanced. Work on the first prototype of a land-based development, the Bv 250, was also in progress. Ordered early in 1942, the Bv 250 was a multi-purpose machine, carrying 88,185 lb. over a range of 1,240 miles as a transport, a 44,100-lb. bomb load over 4,350 miles or an 8,800-lb. bomb load over a range of 6,210 miles as a bomber, and having a maximum range of 8,700 miles in its long-range reconnaissance version. The first four prototypes of the Bv 250 were originally scheduled for delivery during the summer of 1944, but the first prototype had not reached the final assembly stage when further work was abandoned with the cessation of hostilities.

The following specification relates to the Bv 238V1 without armament.

Type: *Long-range Bomber, Reconnaissance and Transport Flying Boat* (*Crew:* 10). **Power Plants:** *Six* 1,750 *h.p. Daimler-Benz DB* 603*V twelve-cylinder inverted-Vee liquid-cooled engines.* **Weights:** *Empty*, 111,984 *lb.; normal loaded*, 154,324 *lb.; maximum*, 176,370 *lb.* **Performance:** *Maximum speed* (*at* 132,280 *lb.*), 216 *m.p.h. at sea level*, 264 *m.p.h. at* 19,685 *ft.*, (*at* 154,324 *lb.*), 212 *m.p.h. at sea level*, 253 *m.p.h. at* 19,685 *ft.; range* (*at* 171,200 *lb.*), 2,395 *mls. at* 6,560 *ft.* **Dimensions:** *Span*, 197 *ft.* $4\frac{3}{4}$ *in.; length*, 142 *ft.* $8\frac{1}{2}$ *in.; height*, 43 *ft.* $11\frac{1}{2}$ *in.; wing area*, 3,928.83 *sq. ft.*

The Bv 238*V1 seen during initial trials in the early spring of* 1944.



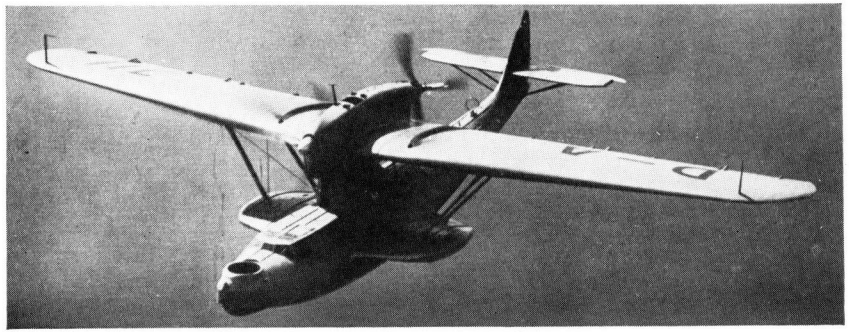
DORNIER DO 18

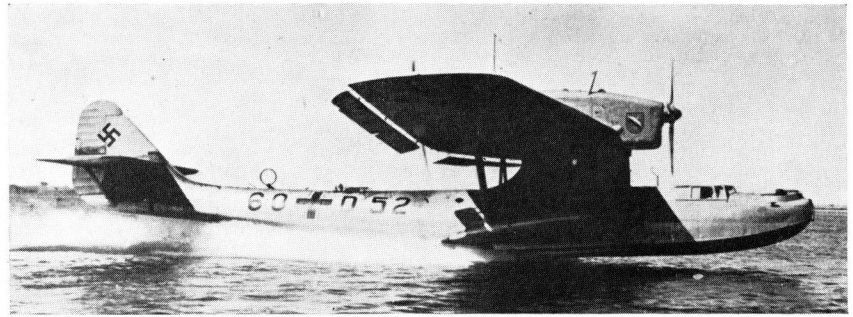
GERMANY

The Do 18 was a direct development of the Wal (Whale) series of flying boats which were probably the most advanced and most successful water-borne aircraft of the 'twenties and early 'thirties. The Do 18 was originally produced as a trans-Atlantic mail-carrier, and the first prototype, the Do 18V1 *Monsun* (D-AHIS) powered by two Junkers Jumo 205 diesel engines of 540 h.p., flew for the first time on March 15, 1935. The Do 18V2 *Zephir* (D-AANE) and V3 *Aeolus* (D-ABYM) were essentially similar to the V1. These and two additional machines were delivered to Deutsche Lufthansa for operation over the South Atlantic under the designation Do 18E. The only other genuine civil flying boat of this type was the experimental Do 18F (D-ANHR) which, built for record-breaking purposes, had wing span increased from 77 ft. 9 in. to 86 ft. 3½ in. and gross wing area from 1,055 sq. ft. to 1,196 sq. ft. All-up weight was increased from 22,000 lb. to 24,200 lb., and the Do 18F was used to establish a distance record of 5,219 miles in 1938. This same aircraft was later experimentally fitted with two BMW 132M air-cooled radials as the Do 18L.

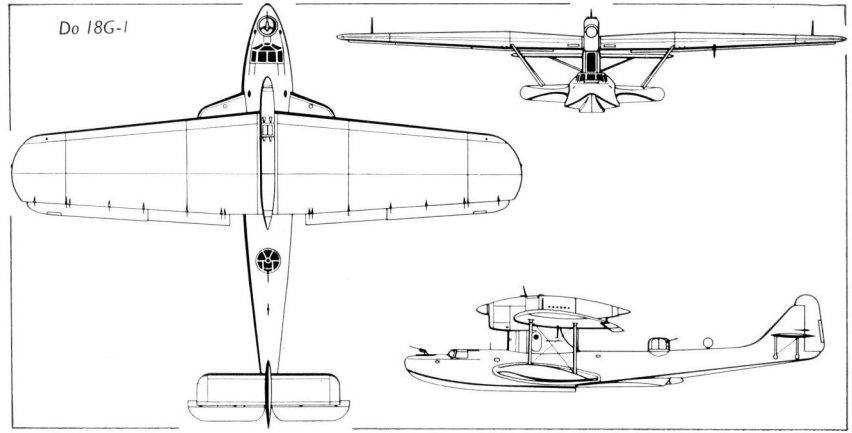
The first military variant and the first production model of the flying boat was the Do 18D with 600 h.p. Jumo 205C engines. Over-

(Above left) The Do 18L with BMW 132M radials and (below) the first military Do 18D.





The Do 18D entered service with the Luftwaffe in 1938, being supplanted by the Do 18G in 1939.



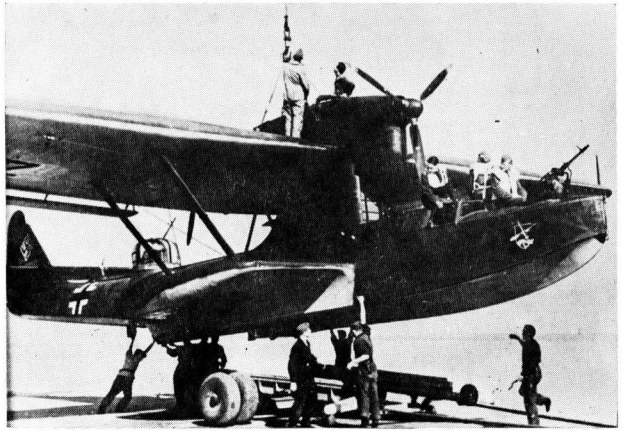
all dimensions were similar to the first prototypes, and after a pre-production batch of Do 18D-0 boats, the aircraft was manufactured in quantity for the reconnaissance role by Weserflugzeugbau as the Do 18D-1 and D-2. The Do 18D carried four crew members, and defensive armament comprised one 7.9-mm. machine gun in an open bow position and a similar weapon in an open hull position aft of the wing. Four light bombs could be carried on racks just outboard of the bracing struts on the wing. The Do 18D entered service with the Luftwaffe in 1938, production being undertaken at Einewarden and Nordenham.

In 1939, production of the Do 18D gave place to the more powerful and more heavily armed Do 18G-1. The Do 18G-1 was powered by two 880 h.p. Jumo 205D engines, and armament comprised a single 13-mm. MG 131 machine gun in the open bow position and a 20-mm. MG 151 cannon in a power-operated dorsal turret. The Do 18H was a basically similar dual-control trainer without armament. Production of the Do 18 terminated in 1940 during which year forty-nine aircraft were manufactured, and a number of Do 18G-1s were modified for the air-sea rescue role under the designation Do 18N-1. Total production of Do 18s of all types barely exceeded one hundred machines.

The following specification relates to the Do 18G-1.

Type: *Maritime Reconnaissance Flying Boat* (*Crew:* 4). **Power Plants:** *Two* 880 *h.p. Junkers Jumo* 205*D six-cylinder double-opposed liquid-cooled diesel engines.* **Armament:** *One* 13-*mm. MG* 131 *machine gun in bow position and one* 20-*mm. MG* 151 *cannon in dorsal turret plus four* 110-*lb. bombs.* **Performance:** *Maximum speed,* 165 *m.p.h. at* 6,560 *ft.; cruising speed,* 140 *m.p.h.; time to* 3,280 *ft.,* 7.8 *min., to* 6,560 *ft.,* 17.5 *min.; service ceiling,* 13,800 *ft.; maximum range,* 2,175 *mls.* **Weights:** *Empty,* 13,180 *lb.; maximum loaded,* 23,800 *lb.* **Dimensions:** *Span,* 77 *ft.* 9 *in.; length,* 63 *ft.* 7 *in.; height,* 17 *ft.* 5½ *in.; wing area,* 1,054.862 *sq. ft.*

A Do 18*G-*1 *on the French channel coast early in* 1942.



DORNIER DO 24 — GERMANY

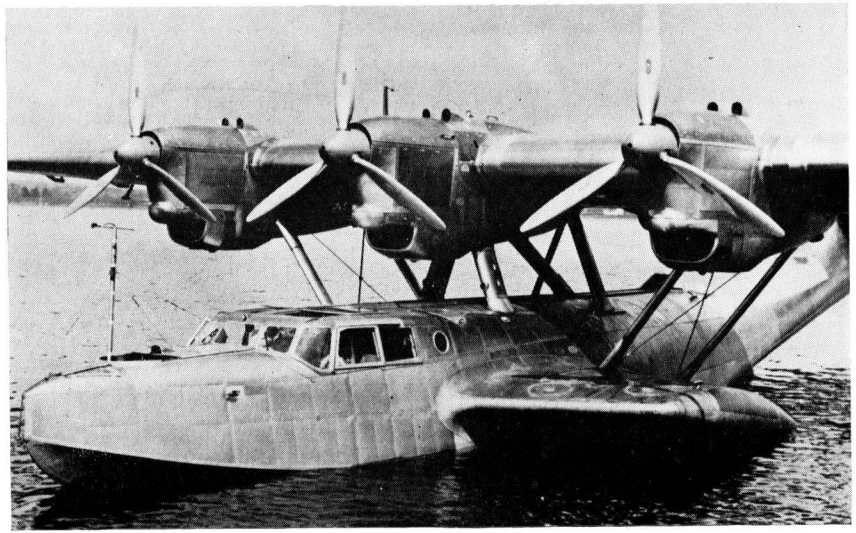
During 1935, the Dornier-Werke obtained an order from the Dutch government for the development of a flying boat suitable for use by the Royal Netherlands Naval Air Service in the East Indies. To meet this requirement, the German concern produced the Do 24, a semi-cantilever monoplane of all-metal construction with *flossentummeln* or sponsons for lateral stability on the water. At the time that design work on the Do 24 was initiated, the Do 18 had just begun flight trials, and the general layout of the flying boat for the Dutch government followed that of the earlier aircraft. Three prototypes were built, the third, the Do 24V3, being intended as the prototype of the export model. This third prototype was actually the first Do 24 to fly, the initial test flight taking place on July 3, 1937, power being provided by three 890 h.p. Wright R-1820-F52 Cyclone radials. The Do 24V1 did not fly until January 10, 1938, this aircraft being powered by three 600 h.p. Junkers Jumo 205C diesel engines as was also the Do 24V2. Both the Do 24V1 and V2 were later to participate in the invasion of Norway, a 7.9-mm. MG 15 machine gun being installed in the bow and tail positions and a 20-mm. MG 151 being housed in a power-operated dorsal turret.

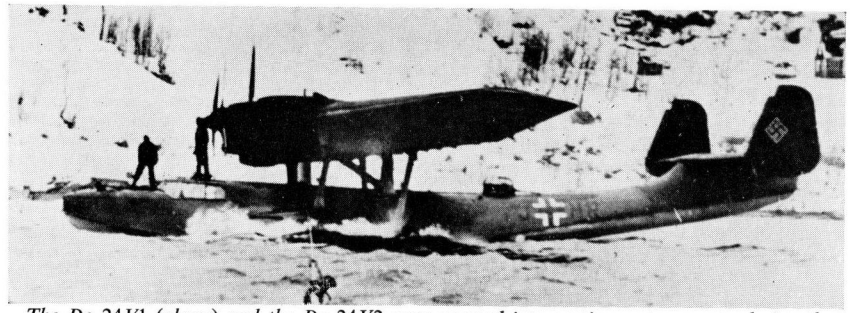
The Do 24V3 was delivered to the Netherlands late in 1937, and a further eleven Cyclone-powered machines were built by Weserflugzeugbau under the export designation Do 24K, these being delivered to the Dutch Navy during 1938-39. A manufacturing licence for the Do 24K was acquired by the Dutch government, the Aviolanda company building the fuselages and the De Schelde company manufacturing the wing assemblies. Dutch production deliveries commenced early in 1939, twenty-five of an order for forty-eight having been delivered by the time the Netherlands were invaded, and a number of aircraft were in service in the East Indies when the Pacific War began. On December 23, 1941, five of the Do 24K flying boats were destroyed in an attack on Davao in the Philippines, and three days later four more Do 24Ks were destroyed at the moorings on Tonduno Lake by strafing Japanese fighters. Five Do 24Ks used for training at Morokrembangan, near Surabaya, were flown to Australia in February 1942, and during the following month, the surviving operational Do 24Ks were also transferred to Australia. Two made forced landings en route, one being destroyed, but the remaining four reached Broome, being sunk at their moorings there in a Japanese air attack on March 3, 1942. Five of the Do 24Ks originally used for training were taken over by the R.A.A.F. (under the designation A-49), and the sixth Do 24K, which had survived the Broome attack as a result of a fuel shortage which had necessitated a forced landing at Wallal while en route to Broome, was used by the Netherlands Forces Intelligence Service on clandestine operations until it was handed over to the R.A.A.F. in October 1943.

The Do 24Ks still under construction in the Netherlands at the time of the German occupation were transferred to Germany, re-equipped, and employed on air-sea rescue duties under the designation Do 24N-1. Production of the Do 24 was continued in the Netherlands after the occupation, Weserflugzeugbau supervising the programme, sixteen being completed in 1941 under the designation Do 24T. The Do 24T-1 and T-2 were intended for both maritime reconnaissance and transport roles, and differed solely in internal equipment, both being powered by Bramo 323R-2 radials. During 1942, the former C.A.M.S plant at Sartrouville, France,

was brought into the Do 24T programme, delivering two flying boats in that year. A total of 154 Do 24T flying boats was completed in the Netherlands from 1942 until the liberation, and the Sartrouville plant produced a further forty-six, although not all of these were received by the Luftwaffe as some unfinished machines at Sartrouville at the time of the German withdrawal were completed for the French Navy, Flottille 9F Tr (Transport) being formed on December 5, 1944, to operate these aircraft. The first two Do 24 flying boats for Flottille 9F were delivered from Sartrouville to Saint Mandrier on December 29, 1944, and in January 1945 twenty Do 24s were under construction at Sartrouville for the French Navy, these subsequently serving in the transport role with Flottille 9F until January 1, 1946, when that unit became Escadrille 30S. The Do 24s served with Escadrille 30S in the air-sea rescue role and performed similar duties with Escadrille 20S, the latter unit being disbanded in October 1949. Escadrille 30S continued operating Do

The Do 24V1 with Jumo engines was, in fact, the second prototype to fly, this event taking place in January 1938.



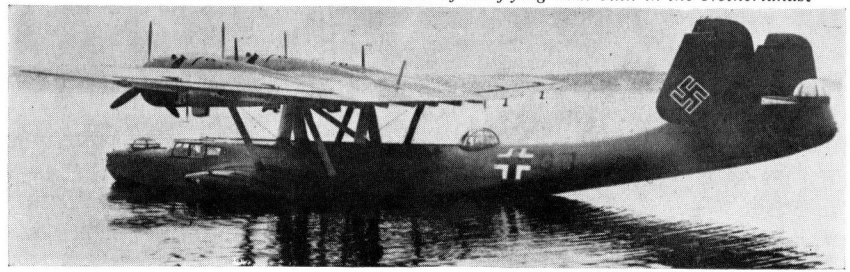


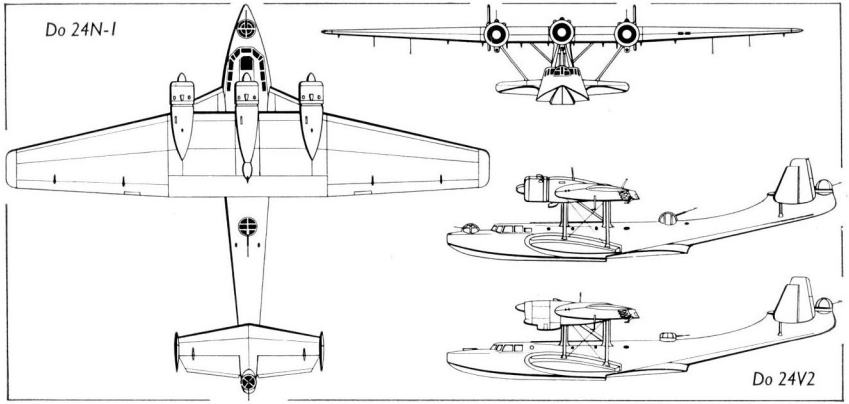
The Do 24V1 (above) and the Do 24V2 were pressed into service as transports during the Norwegian campaign.

24s until disbanded on January 15, 1952, and the last flying boats of this type in service with the French Navy were operated by the flying boat pilot's school at Karouba, Escadrille 53S, until sold to Spain in 1953.

One Do 24T-1 entered service with the Royal Swedish Air Force, this particular aircraft having made a forced landing at Hällevik, Sweden, on October 31, 1944. As the Swedes had no aircraft suitable for the air-sea rescue role, the Do 24T was taken over by the R.Swed.A.F. as the Tp 24, compensation being paid to Germany. There was an agreement that all German aircraft and ships in Sweden at the end of the war that had left the area of Germany that was to become the Russian

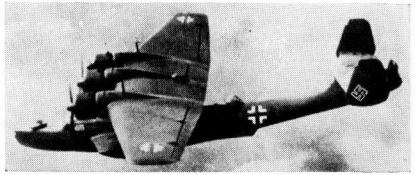
The Do 24N-1 was an air-sea rescue version of the flying boat built in the Netherlands.





Zone were to be handed over to the Soviet Union, and it is an interesting corollary to the story of the sole Swedish Do 24T that the aircraft was eventually claimed by the Soviet Union, a Russian crew arriving in Sweden to ferry the aircraft to the U.S.S.R. in August 1951! In the spring of 1944, twelve Do 24T-3s were purchased by the Spanish government to equip an air-sea rescue squadron subsequently based at Pollensa, these flying boats remaining in service until the present day.

A Dutch-built Do 24N-1 air-sea rescue machine.



The following specification applies to the Do 24T.

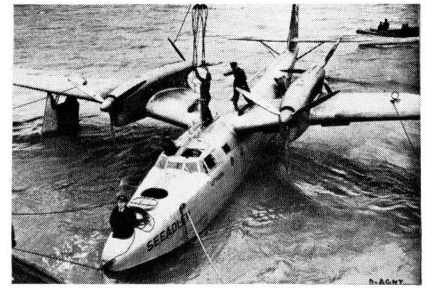
Type: *Maritime Reconnaissance and Transport Flying Boat (Crew:* 5-6). **Power Plants:** *Three* 1,000 *h.p. BMW/Bramo Fafnir* 323*R*-2 *nine-cylinder radial air-cooled engines.* **Armament:** *One* 7.9-*mm. MG* 15 *machine gun in bow and tail positions and one* 20-*mm. MG* 151 *cannon in dorsal turret, plus twelve* 110-*lb. bombs.* **Performance:** *Maximum speed,* 211 *m.p.h. at* 6,560 *ft.; cruising speed,* 183 *m.p.h.; time to* 3,280 *ft.,* 7.5 *min., to* 6,560 *ft.,* 14.5 *min.; service ceiling,* 19,360 *ft.; normal range,* 1,800 *mls.; maximum range,* 2,950 *mls.* **Weights:** *Empty,* 20,062 *lb.; loaded,* 40,565 *lb.* **Dimensions:** *Span,* 88 *ft.* 6⅞ *in.; length,* 72 *ft.* 2⅛ *in.; height,* 18 *ft.* 10⅛ *in.; wing area,* 1,162.5 *sq. ft.*

DORNIER DO 26

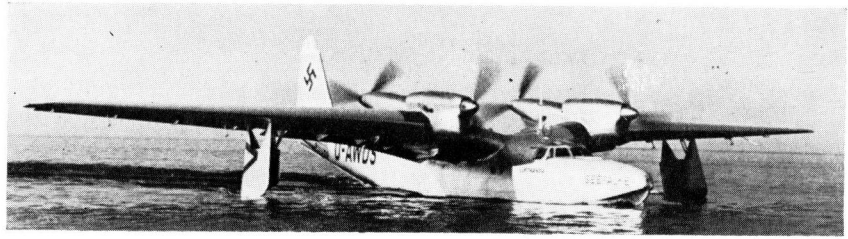
GERMANY

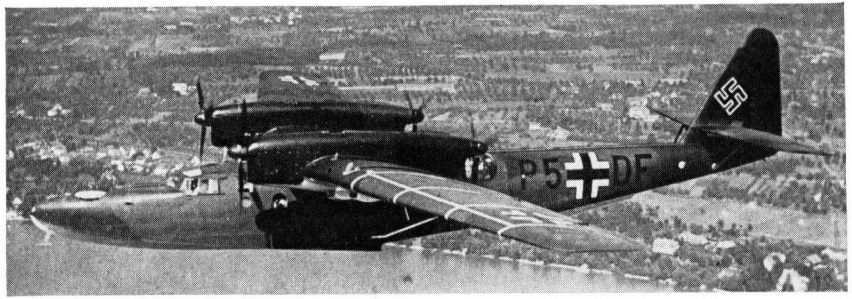
Originally designed for use on the North Atlantic mail services operated by Deutsche Lufthansa, the Do 26 was one of the shapeliest flying boats of its period and embodied several unusual features in its design, the most noteworthy being the engine installation. The four Junkers Jumo diesel engines were mounted in tandem pairs at the extremities of the wing centre section stubs which were built integral with the hull. The rear engines drove pusher airscrews by means of extension shafts on hinged mountings so that they could be raised through an arc of ten degrees, lifting the airscrews clear of water spray during take-off. For the first time in a Dornier flying boat the so-called *flossenstummeln*, or sea-wings, for lateral stability on the water, gave place to outboard stabilising floats, these being fully retractable.

Ordered in 1937, the first prototype, the Do 26V1 *Seeadler* (D-AGNT), flew for the first time on May 21, 1938, powered by four 600 h.p. Jumo 205E engines. This carried four crew members and a 1,100-lb. mail load. The second prototype, the Do 26V2 *Seefalke* (D-AWDS), was similarly powered, and the two aircraft were employed experimentally by Lufthansa under the designation Do 26A, trials including catapult launchings from the deck of a merchant vessel in the Baltic. The third prototype, the Do 26V3, was allocated the civil registration D-ASRA and the Lufthansa name *Seemöwe*. This aircraft was intended as the prototype for the Do 26B series,

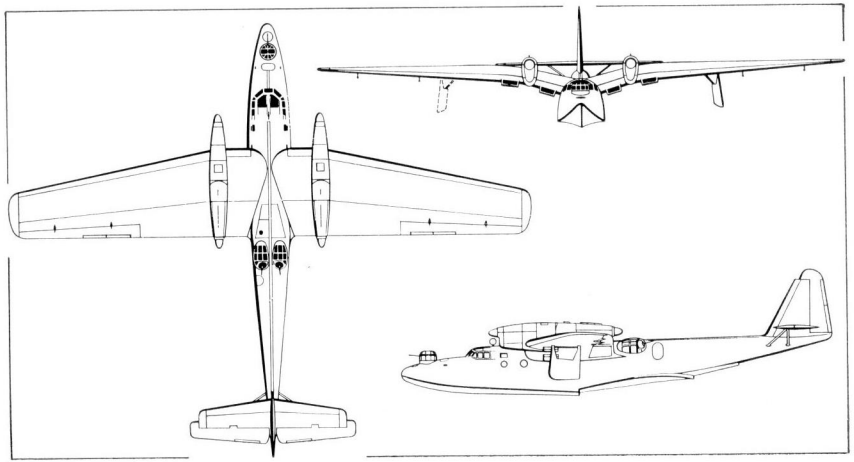


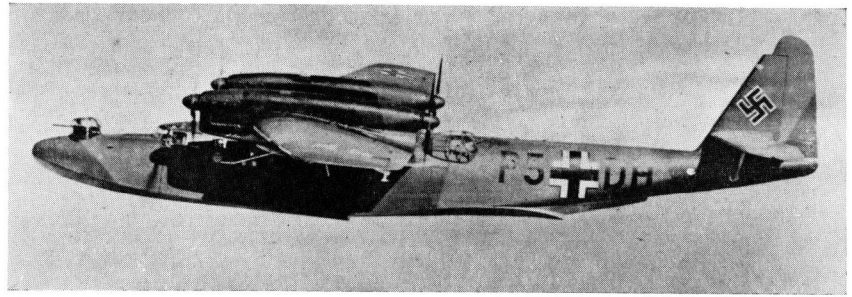
(Above, right) The Do 24V1 "Seeadler" and (below) the Do 24V2 "Seefalke," both later impressed by the Luftwaffe.





The Do 26V4 was the first prototype of the Do 26C series with Junkers Jumo 205Ea engines.

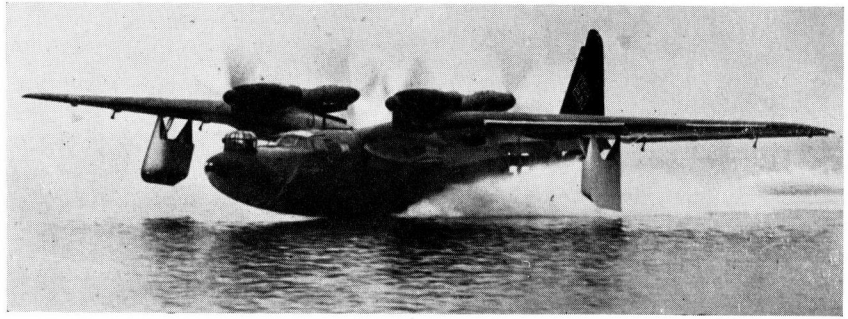


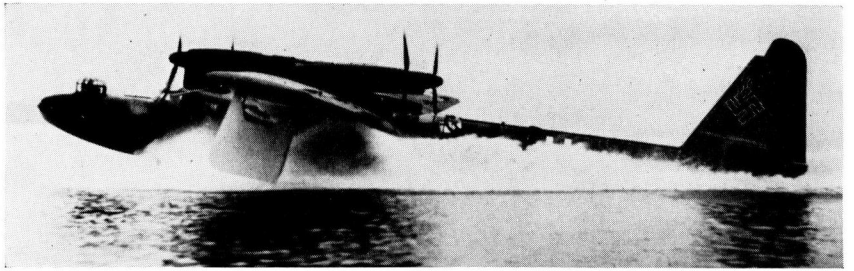


The Do 26 V6 was the last example of this flying boat type to be built and was lost in Norway.

differing from the earlier prototypes in having a compartment for four passengers. Before it could be delivered to Lufthansa, however, hostilities had begun and the aircraft was impressed by the Luftwaffe, being completed for the dual role of military transport and maritime reconnaissance. The conversion included the installation of defensive armament comprising one 20-mm. MG 151 cannon in an electrically-operated turret in the bow,

This photograph of the Do 26V6 shows the extension shafts on the rear engines raised for take-off.





All six Do 26 boats served with the Luftwaffe in the transport role. The Do 26V6 is shown above.

a single hand-held 7.9-mm. MG 15 machine gun in each of two waist blister-type housings, and a third MG 15 in a water-tight position behind the second step of the hull.

At the beginning of the war, three additional Do 26 flying boats were under construction, and these, which bore the *Versuchs* numbers V4 to V6 inclusive, were intended originally as prototypes of the Do 26C with 700 h.p. Jumo 205Ea engines. These were converted in a similar fashion to the Do 26V3, and entered service with the Luftwaffe as transports early in 1940, accommodation being provided for ten–twelve fully-equipped troops. With the invasion of Norway on April 9, 1940, all six Do 26 flying boats were pressed into service, operating from Norwegian fjords in the transport and communications roles. On May 28, 1940, the Hurricanes of No. 46 (F) Squadron encountered two of the Do 26s attempting to disembark alpine troops in Rombaksfjord. Both of the flying boats were shot down, one of these, piloted by a well-known German seaplane pilot, the Graf Schack, making a forced landing near Narvik, the crew and the ten alpine troops on board being captured.

No additional Do 26 flying boats were built, and those that survived the Norwegian campaign continued to serve the Luftwaffe in the communications and transport roles until lack of spares rendered their further operation impossible.

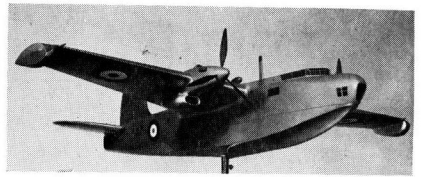
Type: *Long-range Transport Flying Boat.* **Power Plants:** *Four* 700 *h.p. Junkers Jumo* 205*Ea six-cylinder double-opposed liquid-cooled diesel engines.* **Armament:** *One* 20-*mm. MG* 151 *cannon in power-operated bow turret and three* 7.9-*mm. MG* 15 *machine guns in waist and ventral positions.* **Performance:** *Maximum speed,* 208 *m.p.h. at* 8,530 *ft.; maximum cruising speed,* 193 *m.p.h.; time to* 3,280 *ft.,* 7.5 *min., to* 6,560 *ft.,* 14.7 *min ; service ceiling,* 15,750 *ft.; normal range,* 2,980 *mls.; maximum range,* 4,410 *mls.* **Weights:** *Empty,* 23,589 *lb.; normal loaded,* 44,090 *lb.* **Dimensions:** *Span,* 98 *ft.* 5⅛ *in.; length,* 80 *ft.* 8½ *in.; height,* 22 *ft.* 5¾ *in.; wing area,* 1,291.67 *sq. ft.*

BLACKBURN B.20

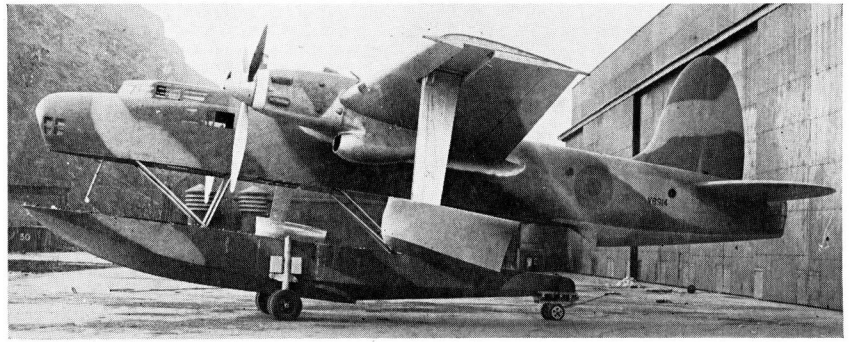
GREAT BRITAIN

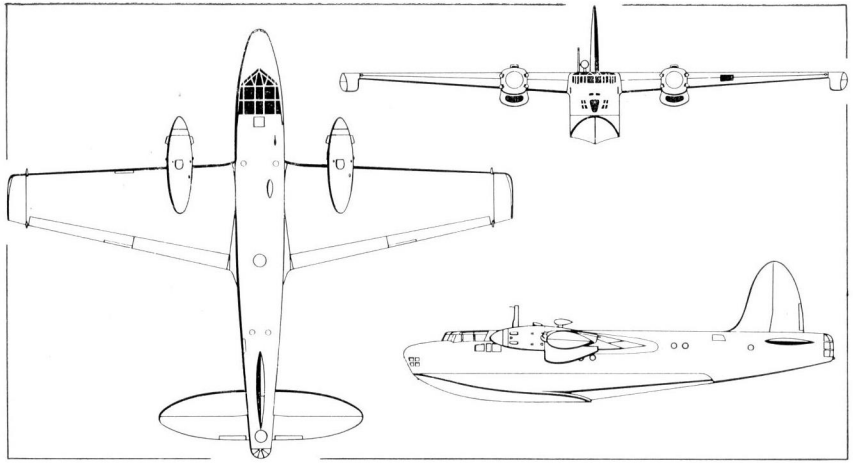
One of the most interesting flying boats to be built and flown during the war years was the Blackburn B.20 medium-range reconnaissance aircraft. The B.20 represented an attempt to reconcile the conflicting requirements for angles of incidence and correct streamlining between the conditions of take-off and level flight, and simultaneously provide adequate clearance between airscrews and water. The novel feature of the B.20 was the use of a retractable planing bottom. The hull was built of aluminium alloy, a normal stressed-skin structure being used with transverse frames and longitudinal stringers, and the structure of the retractable planing bottom or pontoon was similar. The pontoon was sub-divided into five watertight compartments and was attached to the main hull by means of links so designed that when the pontoon was extended the hull and wings automatically assumed the best attitude for take-off. The pontoon had an overall length of 48 ft. 9 in., and when retracted presented a good streamline form with the main hull.

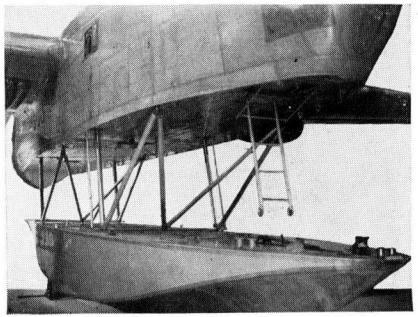
Designed to meet the requirements of specification R.1/36 to which the Saro Lerwick was also designed, the B.20 was completed without the bow and tail turrets proposed in the original design, and was flown for the first time early in 1940, and a number of flights



(*Below*) *The B.20 retractable-hull flying boat and* (*above, right*) *a model showing the hull retracted.*

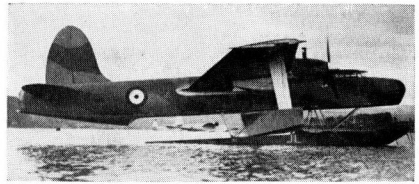






were made, the aircraft performing well both on the water and in the air, and the retractable pontoon operating successfully. Unfortunately, the B.20 was lost during a test flight, and further development of the flying boat was abandoned. However, design work on a further machine employing the retractable pontoon principle was undertaken, but more urgent wartime work finally resulted in its abandonment.

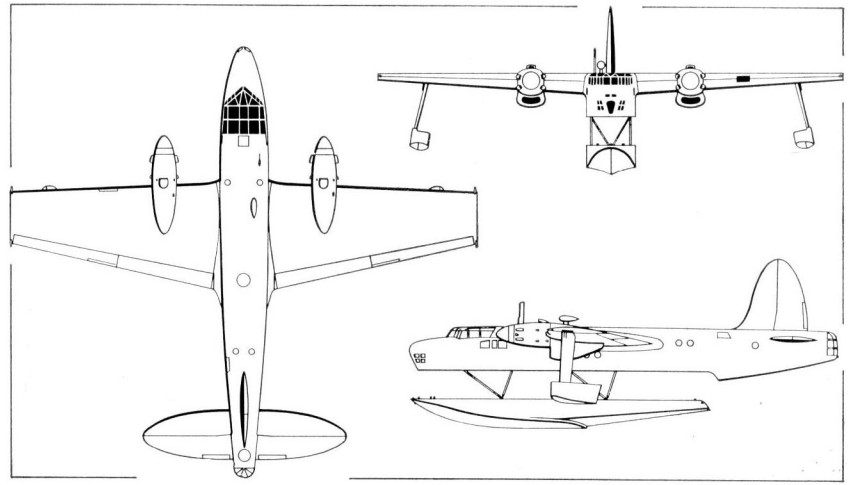
It was proposed that the B.20 would carry bombs in the wing centre section, two bomb cells being arranged on each side of the hull, accommodation being provided for eight 250-lb. bombs. No high-speed trials were conducted with the B.20 during the period that this flying boat was under test, and perform-



The B.20 during trials early in 1940.

ance details quoted in the following specification are based on manufacturer's estimates.

Type: *Medium-range Maritime Reconnaissance Flying Boat.* **Power Plants:** *Two* 1,830 *h.p. Rolls-Royce Vulture twenty-four-cylinder X-type liquid-cooled engines.* **Armament:** (*Proposed*) *Twin* 0.303-*in. machine guns in nose and dorsal turrets and four* 0.303-*in. guns in tail turret, plus eight* 250-*lb. bombs.* **Performance:** (*With armament installed*) *Maximum speed,* 288 *m.p.h. at* 5,750 *ft.,* 306 *m.p.h. at* 15,000 *ft.; economical cruising speed,* 200 *m.p.h.; maximum range,* 1,500 *mls.* **Weights:** *Normal loaded,* 35,000 *lb.* **Dimensions:** *Span* (*floats retracted*), 82 *ft.* 2 *in.,* (*floats extended*), 76 *ft.* 0 *in.; length,* 69 *ft.* 7½ *in.; height* (*pontoon extended*), 25 *ft.* 2 *in.,* (*pontoon retracted*), 22 *ft.* 9 *in.; wing area* (*including floats*), 1,066 *sq. ft.*

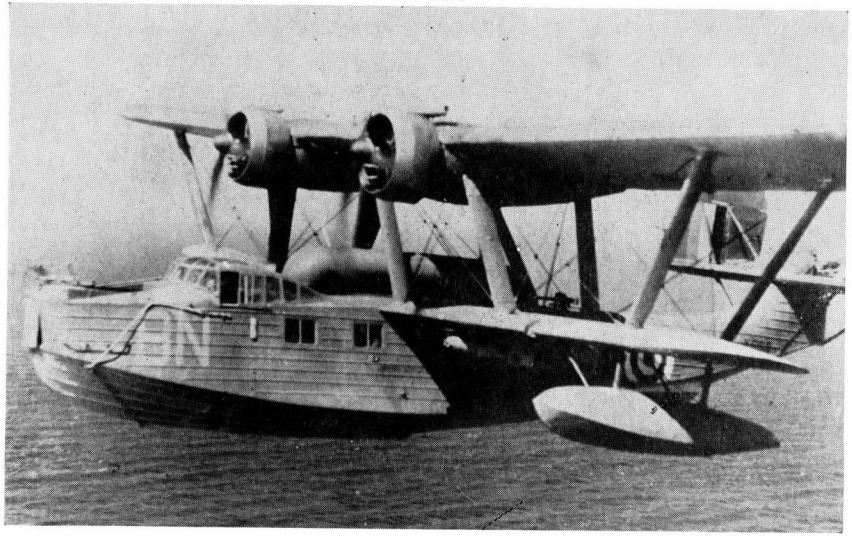


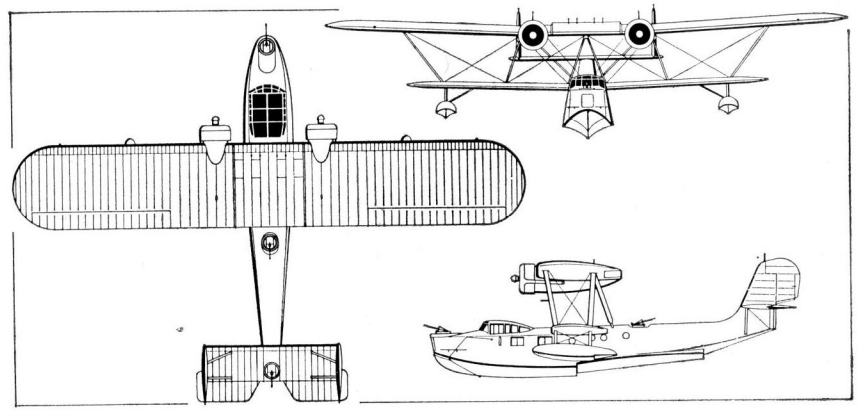
SARO LONDON

GREAT BRITAIN

In general design, the Saro A.27 London followed the practice established by British flying boat designers from the mid 'twenties, and was an all-metal aircraft with fabric-covered wing and tail surfaces. It was designed to specification R.24/31 which called for a twin-engined general-purpose coastal reconnaissance flying boat featuring robustness, low maintenance costs and simplicity of construction. The latter feature was obtained by the use of corrugations to stiffen the hull plating and thus obviate the need for riveted-on stringers. The prototype (K3560) was flown for the first time in 1934 powered by two 750 h.p. Bristol Pegasus III radials, and a production order was placed in March 1935, the name London being officially adopted.

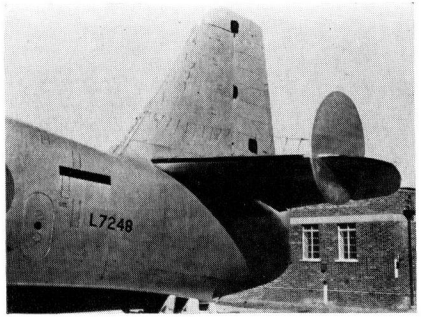
A London II (K5910) of No. 240 Squadron which retained this type during the early months of the war.





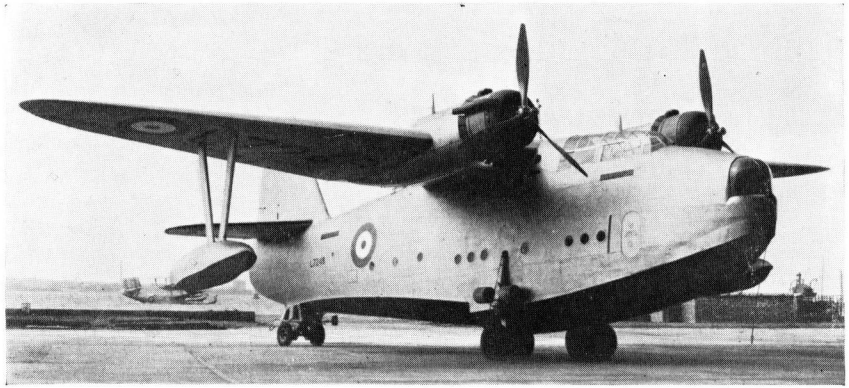
Production deliveries began in 1936, the initial model being the London I powered by Pegasus III engines in polygonal cowlings, but the eleventh and subsequent aircraft received Pegasus X engines in circular cowlings and were known as London IIs, the original prototype having been modified to this standard to conform with specification R.3/35. Thirty-eight London IIs were built, the last of these being completed at Cowes in May 1938. The first squadron to equip with the London was No. 201 at Calshot, this unit being followed by Nos. 202, 204, and 240 squadrons, and with the exception of No. 204 Squadron, these units were still operating the London at the beginning of the war. No. 202 Squadron operated its Londons from Malta and Gibraltar on anti-submarine and convoy patrols, and Nos. 201 and 240 squadrons patrolled the North Sea, the last Londons being withdrawn from operational service early in 1941.

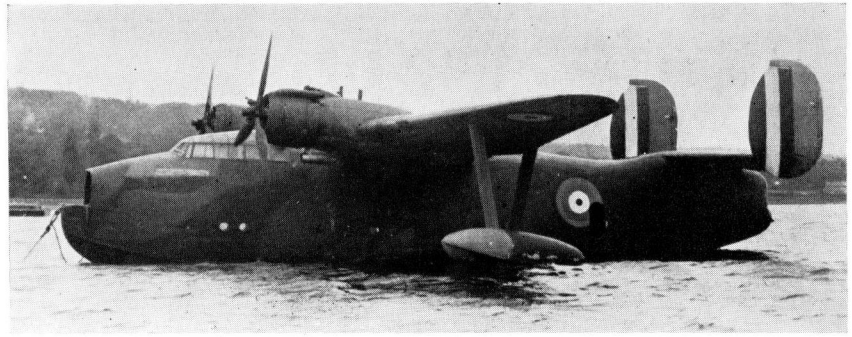
Type: *General-purpose Coastal Reconnaissance Flying Boat (Crew:* 6). **Power Plants:** *Two* 920 *h.p. Bristol Pegasus X nine-cylinder radial air-cooled engines.* **Armament:** *Three swivelling* 0.303-*in. Lewis machine guns in open bow, dorsal and tail positions, plus* 2,000-*lb. load of bombs, mines or depth charges.* **Performance:** *Maximum speed,* 142 *m.p.h. at sea level,* 155 *m.p.h. at* 6,560 *ft.; cruising speed* (70% *power*), 137 *m.p.h. at* 6,560 *ft.,* (60% *power*), 128 *m.p.h. at* 13,120 *ft.; initial climb rate,* 1,180 *ft./min.; service ceiling,* 19,900 *ft.; normal range,* 1,100 *mls.; maximum range* (*with auxiliary tank over hull*), 1,740 *mls.* **Weights:** *Empty,* 11,100 *lb.; normal loaded,* 18,400 *lb.; maximum permissible,* 22,000 *lb.* **Dimensions:** *Span,* 80 *ft.* 0 *in.; length,* 56 *ft.* 6 *in.; height,* 18 *ft.* 9 *in.; wing area,* 1,425 *sq. ft.*



The Saro S.36 Lerwick medium-range reconnaissance flying boat designed to meet the requirements of specification R.1/36 was one of the Second World War's failures, and only twenty-one aircraft of this type were built. The first production Lerwick (L7248), which, together with the second and third machines (L7249 and L7250) served for prototype trials, was completed during the autumn of 1938, but the original hull was found to be unstable, and the balance of the elevators was unsatisfactory. After modifications, take-offs, landings and water runs were conducted at Cowes between January 9 and February 11, 1939, but flight trials indicated that the Lerwick was unstable laterally, exhibiting a tendency to roll and yaw under cruising con-

(*Below*) *The first Lerwick* (L7248) *as originallyflown and* (*above*) *with auxiliary fins and taller rudder.*

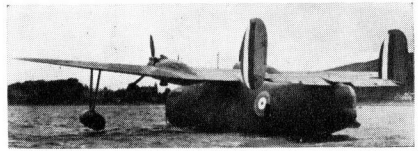




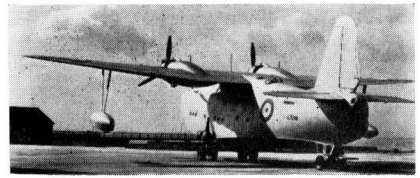
(*Above and below, right*) *The first Lerwick was tested with twin fins and rudders and increased wing incidence.*

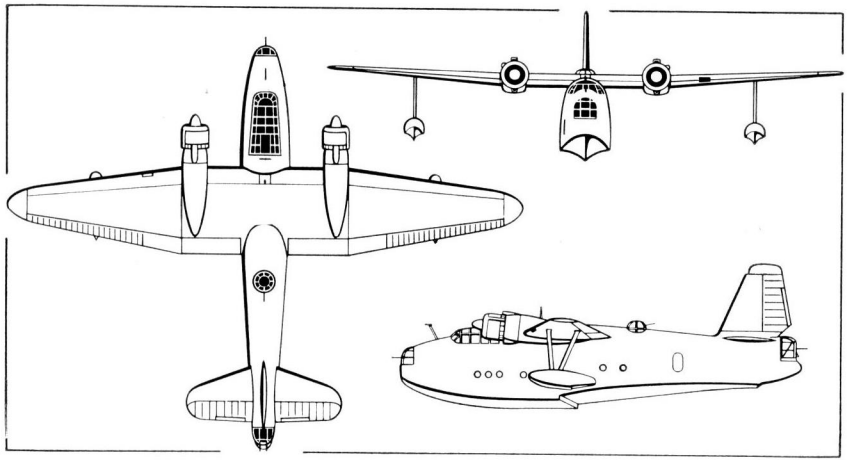
ditions. This behaviour was disconcerting to the pilot and extremely uncomfortable for the crew, and was sufficiently serious to render the aircraft unsuitable for service use. Lateral instability was such that it was impossible to fly the Lerwick "hands off", and attempts to rectify this shortcoming resulted in a variety of modified vertical tail assemblies.

The first Lerwick was fitted with auxiliary fins and an immediate improvement was noticeable, although there was still a tendency to roll and yaw. The auxiliary fins were then removed and the height of the rudder increased, and although there was little tendency to yaw after this modification had been made, the aircraft rolled badly. With the taller rudder and the auxiliary fins the rolling tendency was removed and yawing was substantially reduced, but the most satisfactory solution was found with the fifth aircraft (L7252) on which the taller rudder was coupled with an enlarged fin. Directional control



(*Below*) *The first Lerwick as originally flown with small vertical surfaces which provided inadequate stability.*



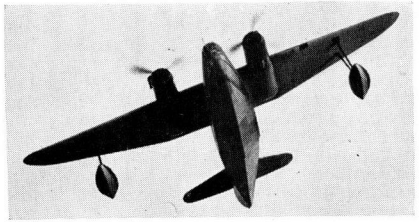


proved adequate and there was only a slight rolling tendency, and this arrangement was adopted for subsequent Lerwicks. In an attempt to improve take-off performance, the angle of the wings to the hull of the seventh Lerwick (L7254) was increased by two degrees and the standard 13 ft. 6 in. diameter airscrews were replaced by airscrews of 14 ft. 6 in. diameter. Trials with this aircraft were conducted in February and March 1940. Take-off performance was much better with the wings set at the more positive angle, and flying qualities were generally improved, but clearance between the airscrews and the water was barely adequate for rough-water conditions. The first Lerwick was, therefore, modified for the increased wing incidence but retained the original airscrews. At the same time it was fitted with twin fins and rudders, the entire tail unit being raised by fifteen inches. On the water there was a noticeable improvement in the Lerwick's characteristics. When trimmed to fly "hands off" at 150 m.p.h., the aircraft still rolled and yawed, the roll worsening with increased speed. Although longitudinal stability was improved, it was still below the standard required for a patrol flying boat.

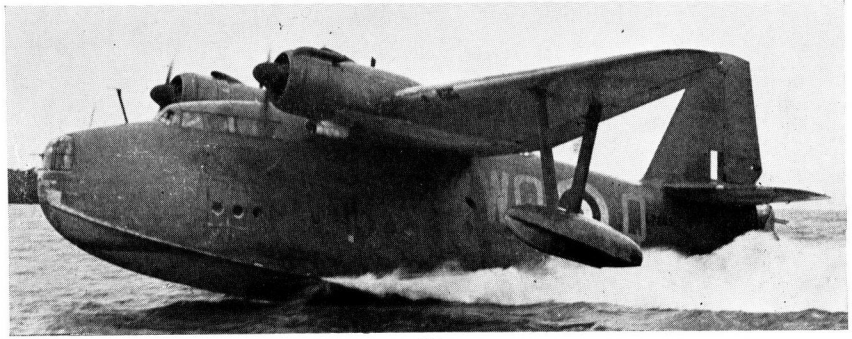
Stalling tests carried out in December 1940 indicated that the Lerwick had a vicious stall with engines off and flaps up, and with engines on and flaps down none of the controls were in the least effective when the aircraft was stalled. Despite its shortcomings, however, the Lerwick entered service with No. 209 Squadron

at Oban late in 1940, but L7255 sank on December 6, 1940, and L7252 was lost on March 24, 1941, and in May 1941 this flying boat was withdrawn from service. The last eight aircraft (L7261–8) were fitted with Hercules IV engines in place of the Hercules IIs, but few of these entered service, being placed in storage and eventually "reduced to produce". The twenty-first and last Lerwick was completed in November 1940. One (L7253) was briefly tested by No. 240 Squadron but was lost on February 20, 1940, a few were used for a short time by No. 4 O.T.U. at Invergordon, and one (L7254) was used as an instructional airframe at the Marine Training School, Wig Bay.

Type: *Medium-range Reconnaissance Flying Boat* (*Crew:* 6). **Power Plants:** *Two* 1,375 *h.p. Bristol Hercules II fourteen-cylinder radial air-cooled engines.* **Armament:** *One* 0.303-*in. Vickers gun in nose turret, twin* 0.303-*in. Browning guns in dorsal turret and four Browning guns in tail turret, plus four* 500-*lb. or eight* 250-*lb. bombs.* **Performance:** *Maximum speed,* 216 *m.p.h. at* 4,000 *ft.; cruising speed,* 166 *m.p.h.; initial climb rate,* 880 *ft./min.; service ceiling,* 14,000 *ft.* **Weights:** *Normal loaded,* 28,500 *lb.; maximum overload,* 33,200 *lb.* **Dimensions:** *Span,* 80 *ft.* 10 *in.; length,* 63 *ft.* 7½ *in.; height,* 20 *ft.* 0 *in.; wing area,* 845 *sq. ft.*



(*Above, right and below*) *A Hercules IV-powered Lerwick* (*L7265*) *used briefly for trials with No.* 209 *Squadron.*



SARO A.37

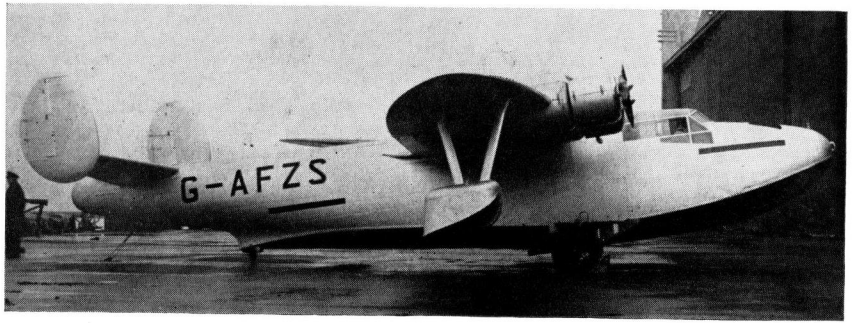
GREAT BRITAIN

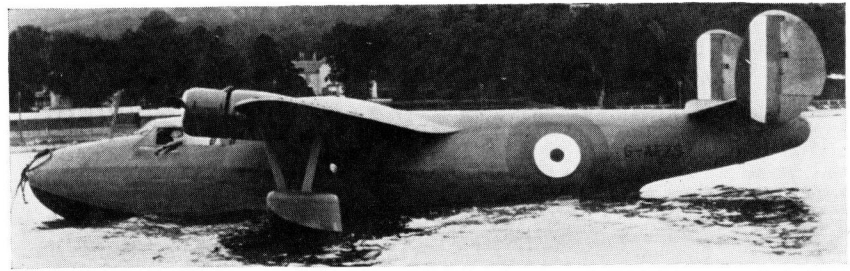
In 1939, as part of a programme connected with the design of large flying boats, Saunders-Roe built a small four-engined flying boat, the A.37, which subsequently became known unofficially as the "Shrimp". The A.37 was intended to provide the answers to various aerodynamic and hydrodynamic problems and, registered G-AFZS, the flying boat was flown for the first time in 1940 with four 88 h.p. Pobjoy Niagara III engines, these being the smallest engines available, and their size having determined that of the A.37.

The A.37 was, in fact, a half-scale model of a large maritime reconnaissance flying boat designed to specification R.3/38 subsequently superseded by R.5/39, and the cabin accommodated the pilot and technical observer in tandem seats. The hull was of all-metal construction while the wings and tail assembly were of wood with plywood and fabric skinning. The fixed wingtip floats were scaled-down replicas of the retractable floats to have been featured by the full-scale aircraft. The A.37 was tested by the Marine Aircraft Experimental Establishment at the beginning of 1941, and the flying qualities of the aircraft proved to be exceptionally good, the controls being light and fully responsive over the whole speed range. The clean hull proved particularly seaworthy for its size, and the handling qualities on the water were excellent.

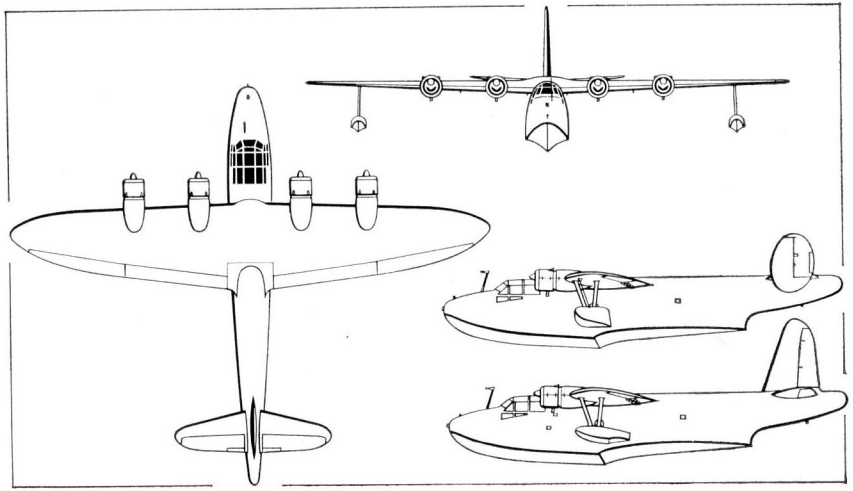
With the replacement of specification R.5/39 by R.14/40, the A.37 was used for Shetland development, and in order to determine the stability characteristics of the Shetland's hull, the A.37 was modified to take a 1:2.75 scale model of the Shetland hull, and attitude, acceleration and stability characteristics were measured in steady runs and take-offs at weights of 5,700 lb. and 6,250 lb. These tests were undertaken at Helensburgh late in 1942, and the A.37 was later fitted with scaled-down

The Saro A.37 as first completed. Camouflage was applied before flight trials were undertaken.





The Saro A.37 during trials at the Marine Aircraft Experimental Establishment early in 1941.

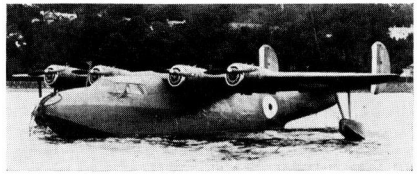


replicas of the Shetland's tail assembly and floats, and tested at 5,600 lb. and 5,700 lb. until the autumn of 1944 under various conditions, including rough sea conditions with winds up to 28 m.p.h., and cross-wind taxying. During these tests the civil registration was replaced by the serial TK580.

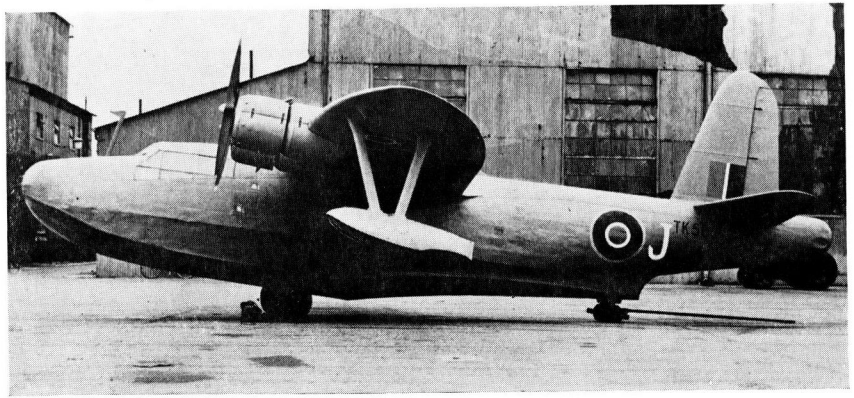
The following specification relates to the A.37 in its original form.

Type: *Two-seat Experimental Flying Boat.* **Power Plants:** *Four* 88 *h.p. Pobjoy Niagara III seven-cylinder radial air-cooled engines.* **Performance:** *Maximum speed,* 130 *m.p.h. at sea level,* 128.5 *m.p.h. at* 2,000 *ft.,* 124.5 *m.p.h. at* 5,000 *ft.; initial climb rate,* 635 *ft./min.; time to* 1,000 *ft.,* 1.6 *min., to* 3,000 *ft.,* 4.95 *min., to* 5,000 *ft.,* 8.65 *min., to* 8,000 *ft.,* 16.5 *min.; normal endurance,* 3 *hr.* **Weights:** *Empty,* 4,362 *lb.; normal loaded,* 5,700 *lb.; maximum,* 6,200 *lb.* **Dimensions:** *Span,* 50 *ft.* 0 *in.; length,* 42 *ft.* 3½ *in.; height,* 12 *ft.* 8¾ *in.; wing area,* 340 *sq. ft.*

(*Below*) *The A.37 during M.A.E.E. trials.*

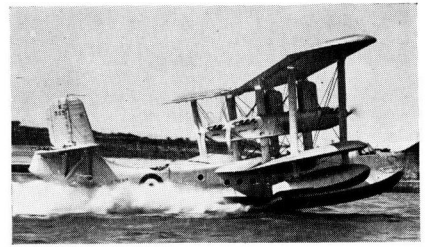


The A.37 fitted with scaled-down replicas of the Shetland's tail assembly and floats.

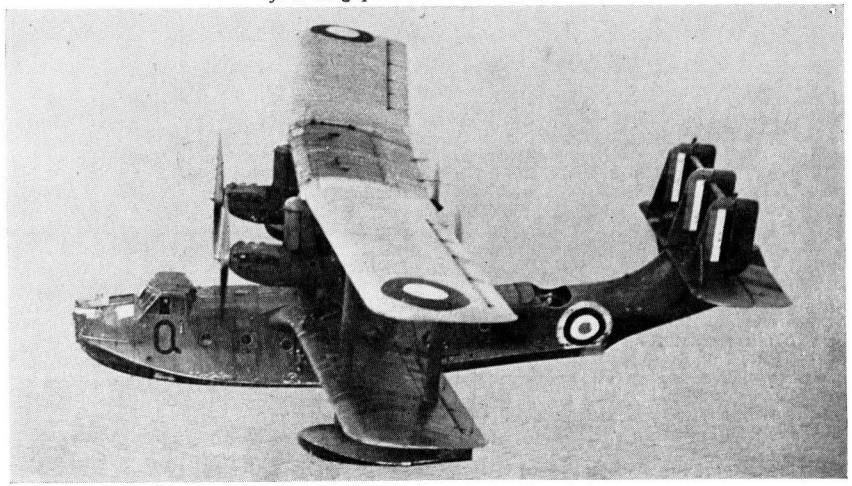


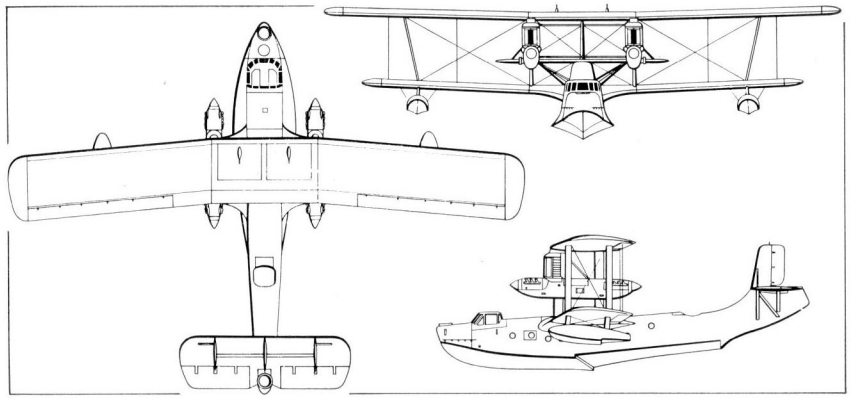
SHORT SINGAPORE III

The Short Brothers' design team, led by Arthur Gouge and C. P. Lipscombe, did much to set the fashion in flying boat design from the mid 'twenties to the mid 'thirties, and was largely responsible for Britain's pre-eminence in this class of aircraft. The Singapore III was the last in a long line of Short biplane flying boats, and stemmed from the original twin-engined S.5 Singapore of 1926, and the experimental four-engined S.12 Singapore II of 1931. In fact, the S.19 Singapore III may be considered as the production model of the Mk. II which had been the first flying boat in



The Singapore III remained in service with Coastal Command during the early war months. The first Singapore III is shown above.





the series to employ the twin tandem power plant arrangement and triple fins and rudders. Four development aircraft had been ordered by the Air Ministry in May 1934, the first of these (K3592) flying two months later, subsequently being designated Singapore III.

Quantity production of the Singapore III began shortly afterwards, the first production aircraft (K4576) flying in March 1935. The first Singapore IIIs were powered by four 640 h.p. Rolls-Royce Kestrel II/III engines but later aircraft had Kestrel VIII/IXs rated at 730 h.p. Five squadrons used the Singapore III, the first unit to receive this flying boat being No. 230 Squadron at Pembroke Dock in April 1935. Nos. 203, 205, 209 and 210 squadrons later used the Singapore, No. 205 Squadron continuing to use this flying boat in the Far East until 1941, and others remained in service in the United Kingdom for a short period after the beginning of the war. Thirty-seven production Singapore III flying boats had been built when the last was delivered in June 1937.

Type: *Overseas General-Reconnaissance and Coastal Patrol Flying Boat* (*Crew:* 6-7). **Power Plants:** *Four* 730 *h.p. Rolls-Royce Kestrel VIII/IX twelve-cylinder Vee liquid-cooled engines.* **Armament:** *Three swivelling* 0.303-*in. Lewis machine guns in open bow, dorsal and tail positions, plus a* 2,000-*lb. bomb load.* **Performance:** *Maximum speed,* 145 *m.p.h. at* 2,000 *ft.; economical cruising speed,* 105 *m.p.h.; initial climb rate,* 700 *ft./min.; service ceiling,* 15,000 *ft.; normal range,* 1,000 *mls.* **Weights:** *Empty,* 18,420 *lb.; normal loaded,* 27,500 *lb.; maximum permissible,* 31,500 *lb.* **Dimensions:** *Span,* 90 *ft.* 0 *in.; length,* 64 *ft.* 2 *in.; height,* 23 *ft.* 7 *in.; wing area,* 1,834 *sq. ft.*

SHORT SCION SENIOR FB

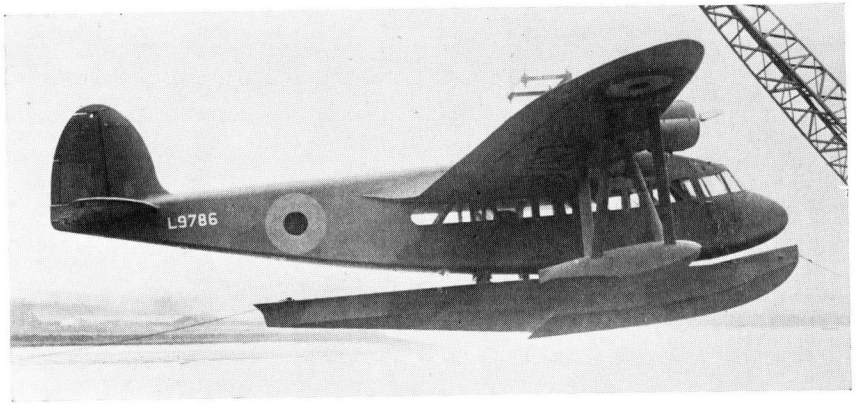
GREAT BRITAIN

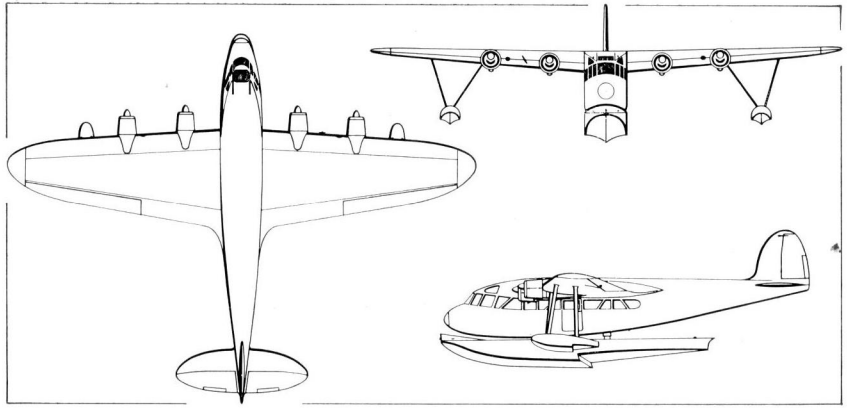
Although the Scion Senior FB was not, strictly speaking, a flying boat, it warrants, inclusion in this volume by reason of the fact that its tests were concerned solely with flying boat hulls, the central float being a half-scale hull attached to the fuselage by two parallel swinging frames which allowed a small movement of the float relative to the fuselage.

Early in 1942, the Marine Aircraft Experimental Establishment found a need for an aircraft capable of testing reduced-scale flying boat hulls as part of a programme aimed at improving the efficiency of planing bottoms. The S.22 Scion Senior, which had been built at Rochester during 1935-36 as a ten-seat light commercial transport, was roughly half the size of the Sunderland flying boat and, fitted with a planing hull, offered characteristics approximating to those of a half-scale model of the flying boat. Short Brothers received a contract to provide technical assistance in the programme, and an impressed Scion Senior (L9786) was fitted with a duralumin flush-riveted central float and outrigger stabilising floats. The slight movement of the float in relation to the fuselage was used to measure hull drag by means of a dynamometer. The step of the Scion Senior hull was further aft than that of the Sunderland so that the c.g. positions relative to the step were the same.

During November 1942, attitude and acceleration were measured and stability characteristics investigated in take-offs, landings and

The Scion Senior FB was fitted with a half-scale model of the Sunderland's planing hull.





steady runs with the Scion Senior FB loaded at 5,900 lb. After initial trials, the original airscrews were replaced by a set with finer pitch in order to improve acceleration at low water speeds, and both unfaired and faired hull steps were tested. In the spring of 1942, the Scion Senior FB was used for so-called "air lubrication" tests by the M.A.E.E. as part of a programme aimed at reducing "skin" friction water drag. The air lubrication, or forced ventilation, tests began in April and terminated in August 1942. Air ejection holes were spaced along the hull and air was released for a part of each take-off, the effect being measured by comparing accelerometer records for take-offs with and without air lubrication made under similar conditions. The air was supplied from four oxygen bottles connected to the duct by means of rubber piping passed through the fuselage to the hull. The results of these trials indicated that no real benefit was to be obtained from air lubrication and further work on the project was abandoned.

The following specification includes performance figures for the twin-float commercial version of the Scion Senior, these being essentially similar to those of the Scion Senior FB.

Type: *Flying Boat Hull Research Floatplane.* **Power Plants:** *Four* 88 *h.p. Pobjoy Niagara III seven-cylinder radial air-cooled engines.* **Performance:** *Maximum speed,* 134 *m.p.h.; economical cruising speed,* 115 *m.p.h.; initial climb rate,* 650 *ft./min.; service ceiling,* 10,000 *ft.* **Weights:** *Loaded,* 5,900-6,000 *lb.* **Dimensions:** *Span,* 55 *ft.* 0 *in.; length,* 43 *ft.* 6 *in.; wing area,* 455 *sq. ft.*

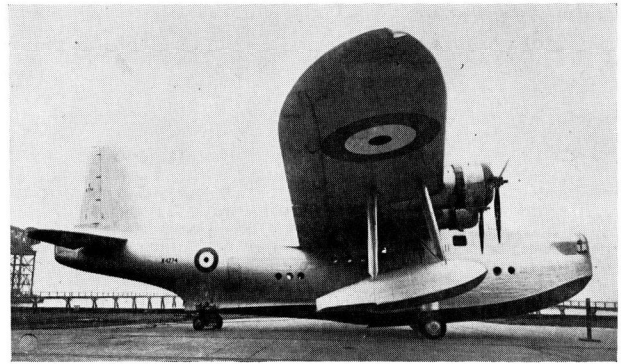
SHORT SUNDERLAND — GREAT BRITAIN

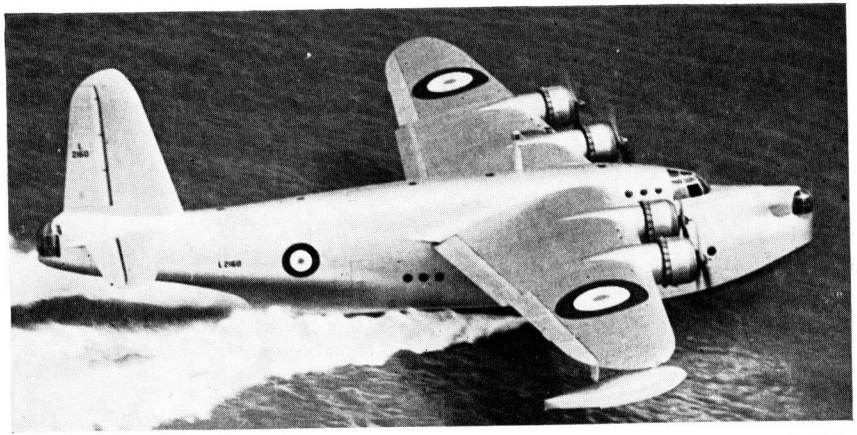
The greatest step forward in the evolution of the large military flying boat and one which brought this class of aircraft to the zenith of its development was represented by the S.25 Sunderland. Embodying all the new aerodynamic and constructional features introduced by its commercial predecessor, the S.23 "C" Class, the Sunderland was notable for being the first flying boat to be equipped with power-operated bow and tail gun turrets, and of the long line of R.A.F. flying boats stretching back to the Felixstowe of the First World War, this remarkable Short seaplane was destined to be not only the last but the greatest! No flying boat employed by any of the Second World War's combatants was to enjoy a more enviable operational record than that of the Sunderland. Serving mostly on anti-submarine and reconnaissance patrols far out into the Atlantic and Indian Oceans, these long-range vigils sometimes necessitating the aircraft being airborne continuously for some fourteen hours, the Sunderland was to be responsible for many outstanding and unusual accomplishments.

The Sunderland was evolved to meet the requirements of specification R.2/33 which called for a four-engined monoplane to succeed the time-honoured biplanes that had served the R.A.F. in the coastal patrol and long-range reconnaissance roles for nearly two decades. Prototypes of two designs were ordered for evaluation, the Saro A.33 and the Short S.25. The design of the Short boat was very much more advanced than that of its rival which, in the event, did not commence trials until October 1938 and, shortly afterwards, suffered a structural failure as a result of porpoising during high-speed taxying in the Solent, and a production order for twenty-one S.25 boats to specification 22/36 had been placed as early as March 1936, eighteen months before the prototype (K4774) made its first flight in October 1937.

The general design and structure of the Sunderland was similar to that of the S.23, although its military role necessitated a complete redesign of the interior of the hull, and

The first prototype Sunderland (*K*4774) *flown in October* 1937.





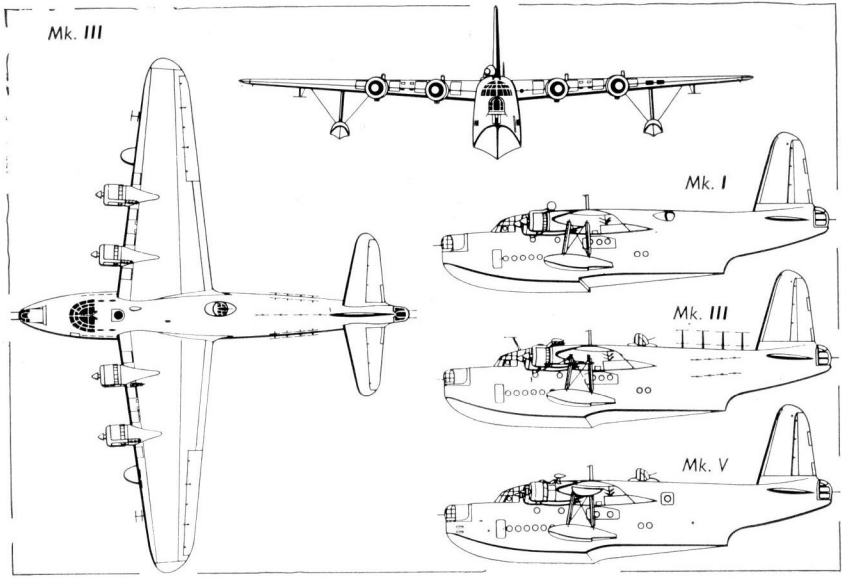
The third production Sunderland I (L2160). *The initial production order was placed in March* 1936.

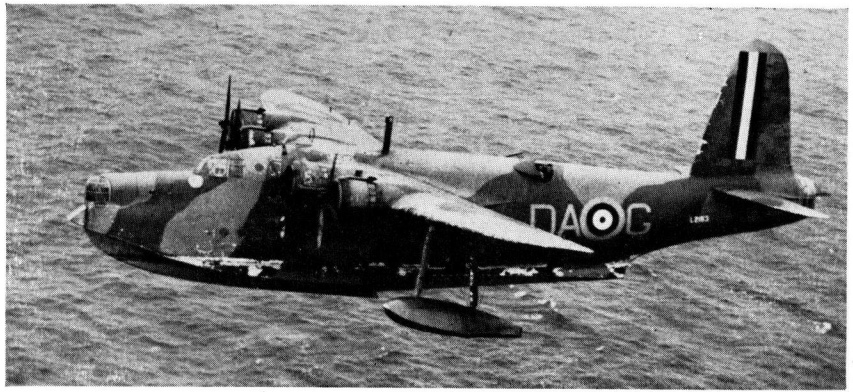
the provision of Fraser-Nash power-operated turrets in the bow and tail radically changed the external appearance of the boat. The introduction of a bow turret necessitated the positioning of the flight deck further aft while, to compensate for the heavy tail turret, slight sweepback had to be introduced on the wings, this resulting in both the engines and the stabilising floats adopting a slight outward cant. Another change was to be seen in the rear step of the hull, a vertical knife edge supplanting the transverse step. The hull of the Sunderland was divided into two decks, and bombs, mines and depth charges were carried on railed racks which could be wound out from the interior of the hull to the undersides of the wings, inboard of the engine nacelles. Defensive armament comprised twin 0.303-in. Browning machine guns in the power-operated bow turret, a single hand-held 0.303-in. gun in each of two beam positions in the top of the hull, aft of the wings, and four 0.303-in. guns in the power-operated tail turret. This armament was soon to earn a healthy respect from the Sunderland's opponents, and its effectiveness was to be demonstrated for the first time on April 3, 1940, when a Sunderland accompanying a small convoy en route for Norway was beset by six Ju 88s, destroying one, seriously damaging another which later crash-landed in Norway and fighting off the rest. When attacked, the Sunderland descended to water-level to protect its vulnerable hull bottom from the attentions of the fighters, and its ability to withstand such onslaughts resulted in it being

dubbed "the Porcupine" by the Luftwaffe.

The initial production model, the Sunderland I, was powered by four Pegasus XXII medium-supercharged engines each offering 1,010 h.p. for take-off and 890 h.p. at 6,500 feet, and one of the most remarkable aspects of the Sunderland's subsequent development was the fact that, while its weight was increased progressively until it was nearly forty per cent greater than when the boat entered service, the engines installed in the final production variant were only marginally more powerful than those with which it first flew! The Sunderland weighed 27,190 lb. in empty condition, and normal loaded and overload weights were 44,600 lb. and 50,100 lb. respectively. Maximum speed was 210 m.p.h. at 6,500 ft., and maximum economical cruising speed was 178 m.p.h. at 5,000 ft. In normal loaded condition the range was 1,780 miles, but overload range was 2,900 miles.

At the outbreak of war, Short Brothers were





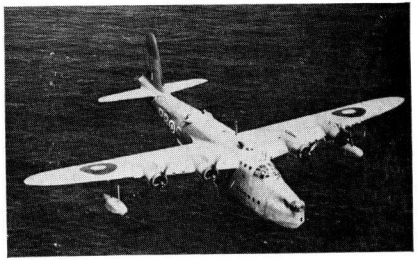
The sixth production Sunderland I (L2163) in service with No. 210 Squadron of Coastal Command.

well embarked on their production of Sunderland I flying boats, and the type had, in fact, begun to enter service in the summer of 1938 with No. 230 Squadron at Singapore and No. 210 Squadron at Pembroke Dock, supplanting the Singapore III biplanes with which these units had been previously equipped. When hostilities began, No. 210 Squadron had been joined in R.A.F. Coastal Command by Nos. 204 and 228 Squadrons, and the versatility of the Sunderland was to be proved on September 21, 1939, when two aircraft from Nos. 204 and 228 Squadrons picked up the entire crew of a torpedoed merchantman, the *Kensington Court*, flying them to safety to complete the first rescue of its kind in history.

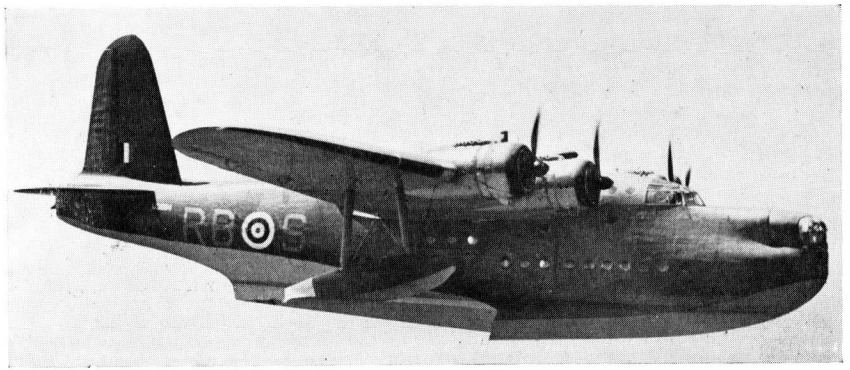
The Sunderland I was progressively introduced into the squadrons during the early months of the war, replacing the obsolescent biplanes, Nos. 95, 201 and 270 Squadrons receiving the initial production model, and this flying boat claimed its first U-boat victim on January 30, 1940, when an enemy vessel was scuttled upon sighting one of No. 228's Sunderlands. Seventy-five Sunderland Is were completed, and these were followed by fifty-eight Sunderland IIs, the first of which was flown in August 1941. Built by both Short Brothers and Blackburn, the Sunderland II differed from the initial model principally in having Pegasus XVIII engines with two-speed superchargers offering 1,050 h.p. for take-off and developing a maximum output of 1,065 h.p. at 1,250 ft. Late production Mk. IIs had the hand-held beam guns replaced by a power-operated dorsal turret with two 0.303-in. guns, but deliveries really got into their stride with the Sunderland III which standardised on the

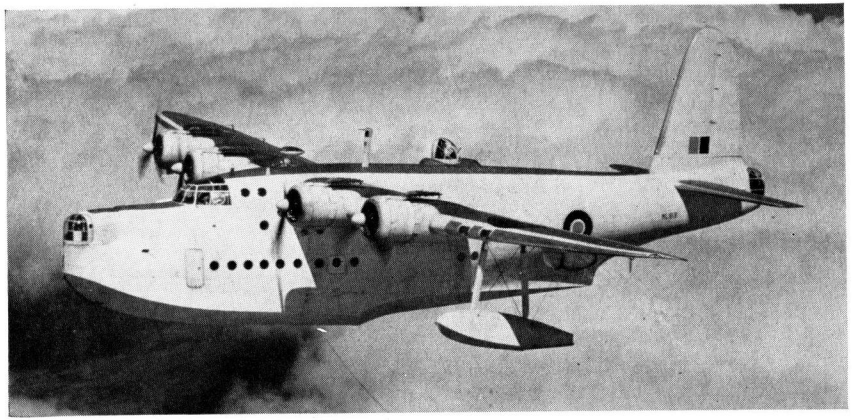
dorsal turret and which flew in prototype form in June 1942. Retaining the engines of the Mk. II, the Mk. III introduced a modified hull planing bottom, the forward step of which was reduced appreciably in depth, and a total of 407 Sunderland IIIs had been delivered by the two manufacturers when production switched to the last variant, the Mk. V, late in 1943.

By the beginning of 1943, R.A.F. Coastal Command possessed nine Sunderland squadrons, and the number of U-boat "kills" began to mount with the delivery of Torpex bombs, Sunderlands previously being gravely handicapped by the lack of suitable depth charges and the need to rely on ineffective 100-lb. and 250-lb. anti-submarine bombs. However, a critical time for the Sunderlands came in that year when U-boats breaking out into the Atlantic through the Bay of Biscay began to fight it out on the surface in packs when attacked by the flying boats. The U-boats were specially armed for the purpose with 37-mm. and 20-mm. cannon on the conning tower as well as machine guns deployed fore and aft, and as the Sunderlands had to make low-level approaches in order to ensure their depth charges straddling the submarines, they



(*Below and above, right*) *The twenty-fourth production Sunderland II (W3984).*





The Sunderland III (above and below, left) introduced a modified hull planing bottom.

were highly vulnerable to the concentrated anti-aircraft fire that they were now called upon to face. On August 1, 1943, a Sunderland III of No. 10 Squadron R.A.A.F., operating with R.A.F. Coastal Command, was shot down in this manner, although its depth charges sent U-454 to the bottom, and this Australian unit became the first squadron to experiment with a fixed battery of four 0.303-in. guns which, mounted in the nose of the Sunderland, was fired by the pilot. This forward-firing armament was intended to clear the enemy gunners from the submarine's conning tower, and its effectiveness was demonstrated on January 8, 1944, when one of No. 10's Sunderlands opened fire at 1,200 yards during an attack on U-426, knocking out all the enemy gunners and sinking the submarine with depth charges. This fixed forward-firing armament was to be standardised on the Sunderland V.

The "*Stachelschwein*", or "Porcupine", as the Luftwaffe had dubbed the Sunderland at an early stage in the war, maintained its reputation for effectively defending itself, absorbing a tremendous amount of punishment and yet surviving. It successfully took on and foiled

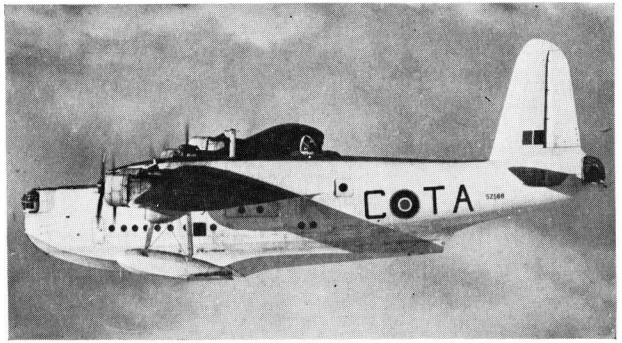
many types of opponents, ranging from most of the enemy fighters to Arado floatplanes and Dornier flying boats. On one occasion, a Sunderland of No. 461 Squadron R.A.A.F. which had suffered some five hundred gashes torn in hull and wings from cannon shells and machine gun bullets put down successfully on a beach, and another that had suffered a hole nine feet by six feet which had been punched in its hull by exceptionally heavy seas, made a successful landing on Angle airfield, South Wales!

By the end of the war, no fewer than twenty-eight Sunderland squadrons were serving with the R.A.F., two of these, Nos. 201 and 228 Squadrons, operating the final production model, the Mk. V. The Sunderland IV was a redesigned, more powerful flying boat subsequently renamed Seaford, and the Mk. V was the first model to switch from Pegasus engines, having R-1830-90B Twin Wasps which each provided 1,200 h.p. for take-off. Some Sunderland Vs had the dorsal turret replaced by two manually-operated 0.5-in. beam guns, and the last of 143 Mk. Vs built was completed at Short Brothers' Belfast plant on June 14, 1946, the last Blackburn-built Mk. V having been completed at Dumbarton on November 8, 1945. Of the 721 Sunderlands of all types built, 250 had been produced by Blackburn.

The following specification relates to the Sunderland V.

Type: *Long-range Maritime Reconnaissance Bomber Flying Boat* (*Crew:* 10). **Power Plants:** *Four* 1,200 *h.p. Pratt and Whitney R*-1830-90*B Twin Wasp fourteen-cylinder radial air-cooled engines.* **Armament:** *Two fixed forward-firing* 0.303-*in. machine guns, two* 0.303-*in. guns in power-operated bow turret, one* 0.5-*in. machine gun in each beam position and four* 0.303-*in. guns in power-operated tail turret, plus a* 4,960-*lb. load of bombs, mines and depth charges.* **Performance:** *Maximum speed,* 207 *m.p.h. at sea level,* 213 *m.p.h. at* 5,000 *ft.; economical cruising speed,* 133 *m.p.h. at* 2,000 *ft.; initial climb rate,* 840 *ft./min.; time to* 12,000 *ft.,* 16 *min.; service ceiling,* 17,900 *ft.; range* (*with* 1,668-*lb. bomb load*), 2,690 *mls. at* 133 *m.p.h. at* 2,000 *ft.* **Weights:** *Empty,* 36,900 *lb.; normal loaded,* 60,000 *lb.; maximum,* 65,000 *lb.* **Dimensions:** *Span,* 112 *ft.* 9½ *in.; length,* 85 *ft.* 3½ *in.; height,* 34 *ft.* 6 *in.; wing area,* 1,687 *sq. ft.*

The final production model, the Sunderland V, had Twin Wasps.



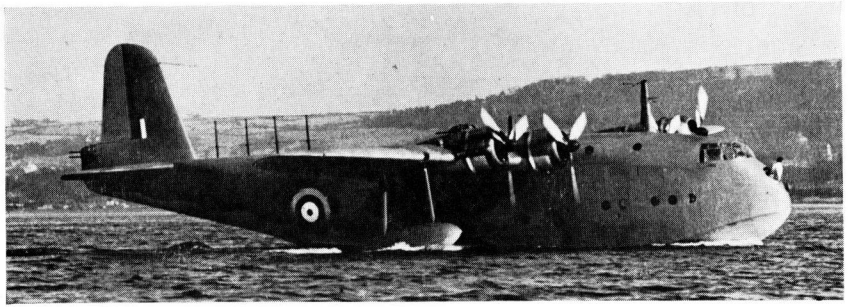
SHORT "C" CLASS (MILITARY) — GREAT BRITAIN

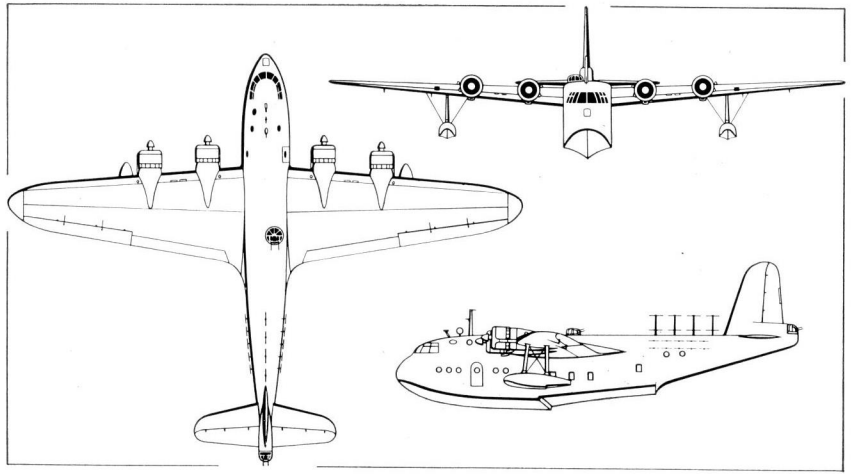
The Short "C" Class Empire flying boat the prototype of which, *Canopus*, flew for the first time on July 4, 1936, represented a major step forward in seaplane design, and thirty-nine boats of this type were built for Imperial Airways and Qantas Empire Airways. The majority of the "C" Class aircraft were of the S.23 type, powered by four 920 h.p. Bristol Pegasus Xc radials and having a loaded weight of 40,500 lb., this later being increased to 43,500 lb. The last eight boats were of a modified type, the S.30, powered by four 890 h.p. Bristol Perseus XIIc engines and strengthened to operate at a loaded weight of 48,000 lb.

Nine of the S.23s and one of the S.30s had been lost in crashes before the war, and two S.30s, *Cabot* and *Caribou*, were impressed by the R.A.F. at the commencement of hostilities as V3137 and V3138 respectively. These were employed by No. 119 Squadron from Invergordon and Islay on early A.S.V. radar trials, but with the invasion of Norway by German forces, the two S.30s reverted to their transport role, but both machines were attacked and sunk by the Luftwaffe in Bodo Fjord while disembarking radar equipment and R.A.F. personnel, *Caribou* being lost on May 5, 1940, and *Cabot* being lost the following day.

Two S.23s, *Clio* and *Cordelia*, were subsequently taken over as replacements, these becoming AX659 and AX660. Both flying boats were modified for the maritime reconnaissance role under the designation S.23M. A.S.V. radar equipment was installed and turreted defensive armament was provided. Boulton Paul "A" Type Mk.II turrets each housing four 0.303-in. Browning Mk.II machine guns were mounted in dorsal and tail positions, the dorsal turret being offset to starboard, the port pilot's seat was fitted with ⅜-in. back armour, a ¼-in. armour plate bulkhead between the navigator's compartment and the flight engineer's station in the upper deck provided protection from rear attack, and the inner fuel tanks were protected by ¼-in. armour plate. Provision was made for the stowage of reconnaissance flares, smoke floats, marine distress signals, etc., and universal bomb carriers were attached beneath the inboard wing sections.

One of the two S.23M boats (AX659), originally Clio, *employed by R.A.F. Coastal Command.*





The two S.23M flying boats were delivered to No. 119 Squadron and operated from Loch Indail on patrol duty between Scotland and Iceland during 1941. One of the boats, *Clio*, was lost during the course of an operational patrol.

The following specification (with the exception of armament details) applies to the S.23 "C" Class boat prior to conversion for military duties.

Type: (*S.23M*) *Maritime Reconnaissance Flying Boat* (*Crew:* 6-7). **Power Plants:** *Four* 920 *h.p. Bristol Pegasus Xc nine-cylinder radial air-cooled engines.* **Armament:** (*S.23M*) *Two Boulton Paul turrets each containing four* 0.303-*in. Browning machine guns in dorsal and tail positions, plus* 2,000-*lb. bomb load.* **Performance:** *Maximum speed,* 200 *m.p.h. at* 5,500 *ft.; maximum cruising speed,* 164 *m.p.h.; initial climb rate,* 950 *ft./min.; ceiling,* 20,000 *ft.; normal range,* 810 *mls.* **Weights:** *Empty,* 24,820 *lb.; normal loaded,* 40,500 *lb.* **Dimensions:** *Span,* 114 *ft.* 0 *in.; length,* 88 *ft.* 0 *in.; height,* 31 *ft.* 9¾ *in.; wing area,* 1,500 *sq. ft.*

SHORT "G" CLASS (MILITARY) — GREAT BRITAIN

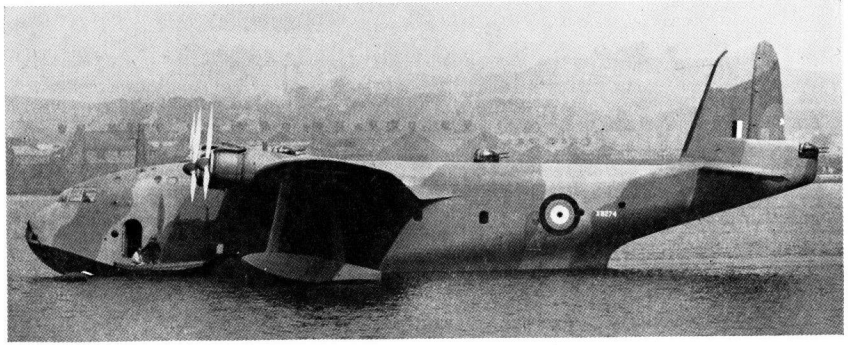
Although the Short S.26 "G" Class flying boat was superficially similar to the "C" Class Empire boat, it was, in fact, considerably larger, and was intended for non-stop mail services across the North Atlantic. The first "G" Class boat, the *Golden Hind*, was flown in June 1939, and two additional aircraft of this type were completed, the *Golden Fleece* and the *Golden Horn*. In 1940, all three flying boats were taken over by the Air Ministry as X8275, X8274, and X8273, and delivered to Rochester for conversion for the maritime reconnaissance role.

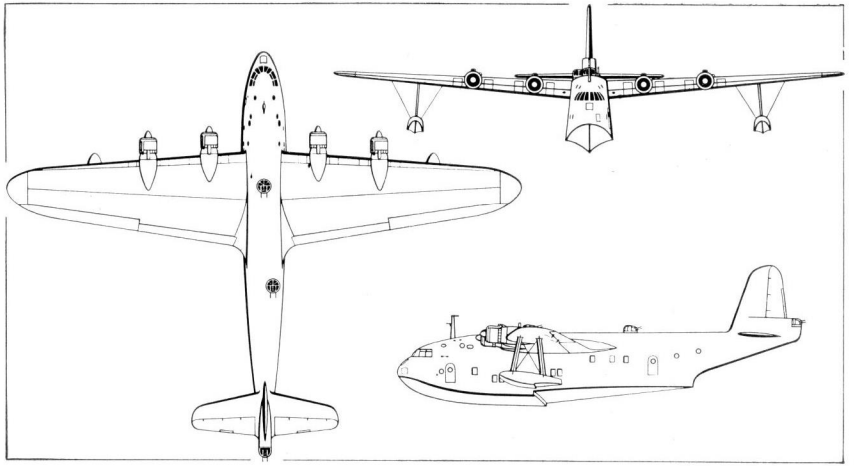
Known as the S.26M in military form, the "G" Class flying boat was fitted with three Boulton Paul Type "A" Mk.II turrets each housing four 0.303-in. Browning guns. The forward turret was mounted between the wing spar frames slightly to starboard of the centre line of the aircraft; the centre turret was also mounted in the hull roof and was offset to starboard aft of the wing trailing edges, and the third turret was mounted in the extreme tail. Four 600-round ammunition boxes were fitted in each turret, and another four boxes were stowed in racks adjacent to each turret. Armour protection was provided for the crew and the inboard fuel tanks, total weight of armour being slightly more than 1,100 lb. Compartments were provided internally for the stowage of twenty 4.5-in. reconnaissance flares, eight smoke floats and twenty-eight flame floats, and a flare launching chute could be mounted over a hatch in the floor of the rear compartment. A maximum bomb load of 2,000 lb. could be carried, eight 250-lb. bombs being fitted to universal carriers immediately aft and on either side of the four engine nacelle fairings.

The three S.26M flying boats were operated by No. 119 Squadron, and one, *Golden Fleece* (X8274), was lost in August 1941 when two engines failed simultaneously off Finisterre. The remaining two machines continued in service until December 1941 when No. 119 Squadron was disbanded, and they were subsequently returned to civil life under B.O.A.C. ownership, reconditioned and issued with commercial certificates of airworthiness. They later flew priority passengers and diplomatic mail, but *Golden Horn* crashed into the Tagus and was lost on January 9, 1943, as a result of an engine fire which followed a mechanical failure.

The following specification (with the exception of armament details) applies to the S.26 "G" Class boat prior to conversion for military duties.

One of the three "G" Class boats (X8274), formerly Golden Fleece, *operated by No. 119 Sqdn.*





Type: (*S.26M*) *Maritime Reconnaissance Flying Boat* (*Crew:* 7-8). **Power Plants:** *Four* 1,380 *h.p. Bristol Hercules IV fourteen-cylinder radial air-cooled engines.* **Armament:** *Three Boulton Paul turrets each containing four* 0.303-*in. Browning machine guns, plus* 2,000-*lb. bomb load.* **Performance:** *Maximum speed,* 209 *m.p.h. at* 5,500 *ft.; maximum economical cruising speed,* 180 *m.p.h. at* 7,500 *ft.; range,* 3,200 *mls. at* 161 *m.p.h.* **Weights:** *Empty,* 37,700 *lb.; loaded,* 74,500 *lb.* **Dimensions:** *Span,* 134 *ft.* 4 *in.; length,* 103 *ft.* 2 *in.; height,* 37 *ft.* 7 *in.; wing area,* 2,390 *sq. ft.*

SHORT SEAFORD

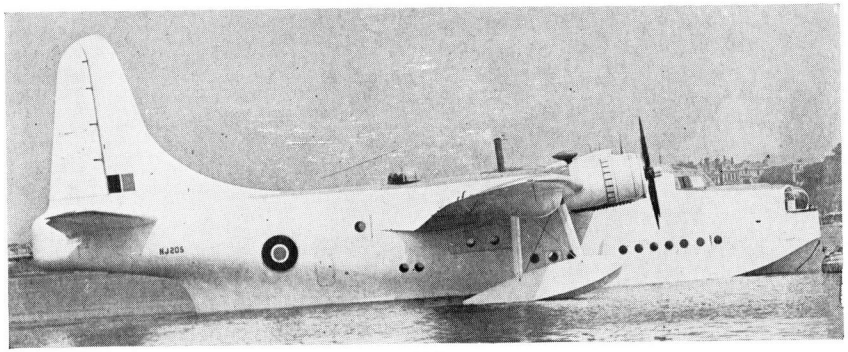
GREAT BRITAIN

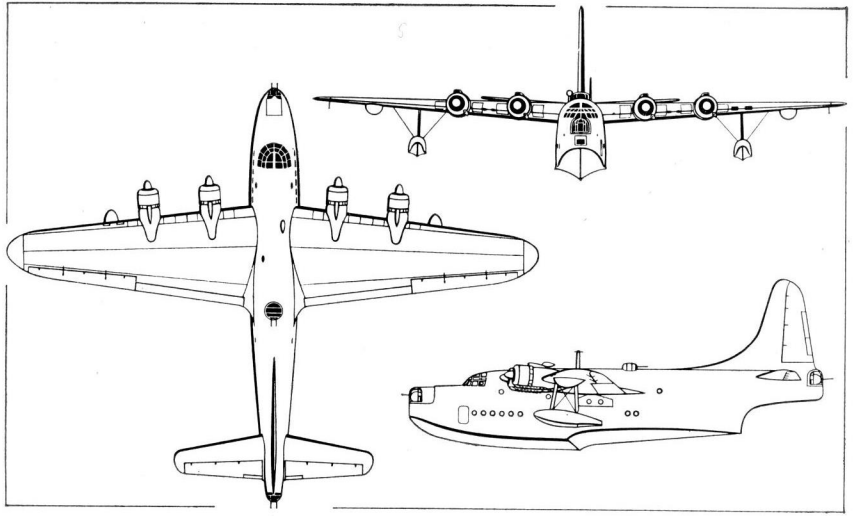
The S.45 Seaford was derived from the Sunderland III to meet the requirements of specification R.8/42, and was, in fact, originally known as the Sunderland IV. The specification called for a more powerful, more heavily armed flying boat to operate at an all-up weight of 75,000 lb. and intended for use in the Pacific. Two prototypes (MZ269 and MZ271) and thirty production Seafords (NJ200–229) were ordered, and the first prototype was flown in April 1945.

By comparison with the Sunderland, the Seaford had a strengthened wing, the hull beam was increased by flared chines, the forebody and afterbody being lengthened and step depth increased, the areas of the tailplane and elevators were increased and greater water clearance was given by dihedral and a raised root, and defensive armament was increased. Armament comprised two 0.5-in. machine guns in a Brockhouse bow turret with 500 r.p.g., two 20-mm. Hispano cannon with 350 r.p.g. in a B-17 dorsal turret, two 0.5-in guns in a Glenn Martin tail turret, two 0.303-in. Browning guns in the nose decking with 500 r.p.g. and two 0.5-in. guns in beam positions. Bomb and depth charge loads and stowage were similar to those of the Sunderland V. The prototypes were powered by 1,680 h.p. Hercules XVII engines, but these were supplanted in the production Seaford by 1,720 h.p. Hercules XIXs.

The second production Seaford (NJ201) was loaned to B.O.A.C. for evaluation as a commercial transport in 1946, and as a result of these trials an order was placed for twelve similar aircraft powered by Hercules 637 engines and accommodating up to thirty passengers on two decks. These aircraft, which had been laid down as Seaford reconnaissance aircraft, were known as Solent 2s, the first of them being launched on November 11, 1946. In the meantime, a total of eight Seafords had been completed, including the machine evaluated by B.O.A.C., and after a brief trial period with No. 201 Squadron, seven of the Seafords were returned to Short Brothers for conversion as Solent 3 transports.

The sixth production Seaford (NJ205) used for a brief trial period by No. 201 Squadron.

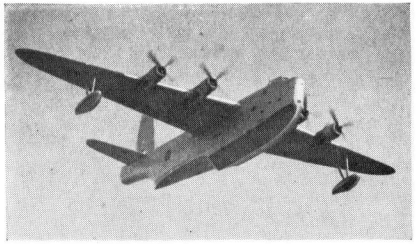




Type: *Long-range Maritime Reconnaissance Flying Boat (Crew: 9-10).* **Power Plants:** *Four 1,720 h.p. Bristol Hercules XIX fourteen-cylinder radial air-cooled engines.* **Armament:** *Two 0.5-in. machine guns in each of nose and tail turrets, two 20-mm. cannon in dorsal turret, two fixed forward-firing 0.303-in. guns and two 0.5-in. beam guns, plus a 4,960-lb. load of bombs, mines and depth charges.* **Performance:** *Maximum speed, 240 m.p.h. at sea level, 242 m.p.h. at 500 ft., 238 m.p.h. at 5,000 ft.; normal cruising speed, 155 m.p.h. at 5,000 ft.; initial climb rate, 880 ft./min.; time to 10,000 ft., 18 min.; service ceiling, 14,000 ft.; range, 2,800 mls. at 155 m.p.h. at 5,000 ft.* **Weights:** *Empty, 45,000 lb.; loaded, 75,000 lb.* **Dimensions:** *Span, 112 ft. 9½ in.; length, 88 ft. 6¾ in.; height, 37 ft. 3 in.; wing area, 1,687 sq. ft.*

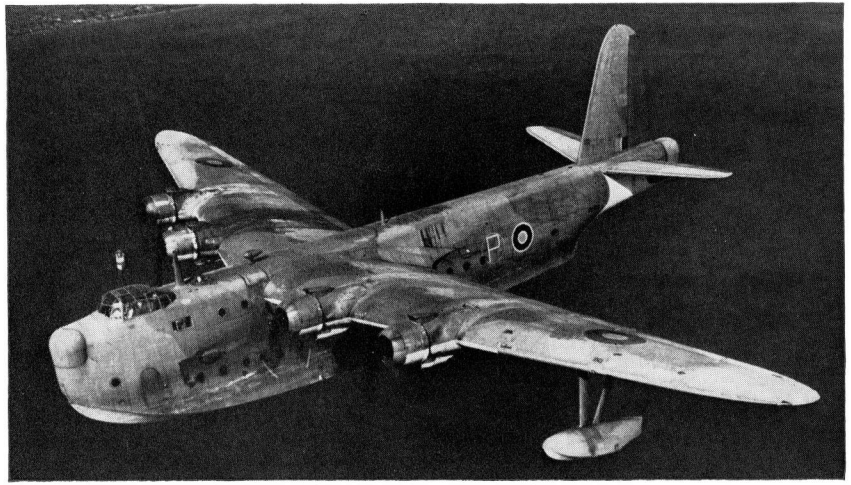
SHORT SHETLAND

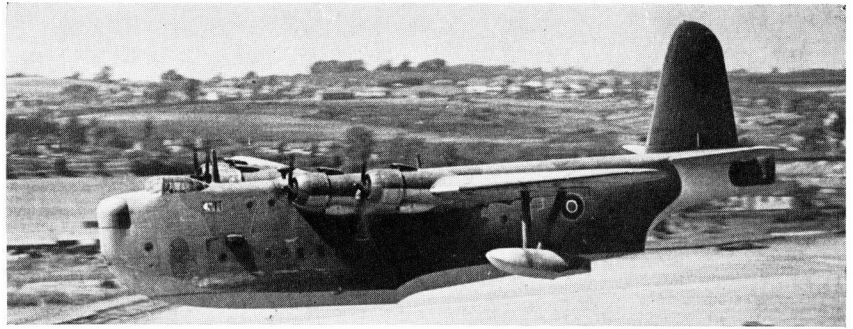
GREAT BRITAIN

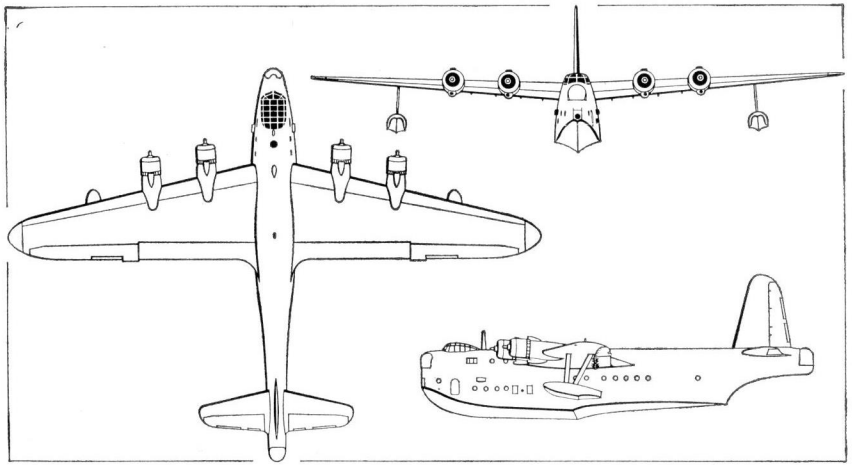


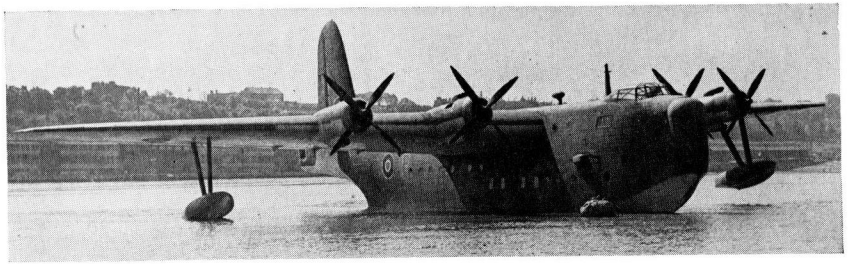
Conceived as a long-range reconnaissance flying boat to the requirements of specification R.14/40 which called for a four-engined flying boat capable of carrying a 4,000-lb. bomb load and heavy defensive armament, the S.35 Shetland was designed and constructed by Short Brothers with the collaboration of Saunders-Roe. Design work was initiated by Short Brothers in 1940, and the company was responsible for the detail design and manufacture of the component parts of the

(*Above, left and below*) *The prototype Shetland I* (*DX*166) *which flew on December* 14, 1944.









wings, including the flaps, ailerons, engine mountings and wingtip floats.

The Shetland was of typical Short design, and two prototypes were ordered, the first of these (DX166) making its initial flight from the Medway on December 14, 1944. By this time, many changes had taken place in operational requirements, and the prototype was not fully equipped for military duties, being fitted with dummy nose and tail turrets but with no military equipment.

After initial manufacturers' trials, the Shetland was delivered to the Marine Aircraft Experimental Establishment at Felixstowe for type trials in October 1945. These trials were not entirely satisfactory. Water handling was acceptable, the hull having good stability and spray characteristics, but the stabilising floats possessed insufficient clearance for take-offs at a loaded weight of 125,000 lb. Harmonisation of the controls was not good, the power-assisted ailerons being too light and the elevators too heavy, and longitudinal stability in level flight was marginal. Type trials with the Shetland were curtailed by the complete loss of the aircraft when it was burned out at its moorings on January 28, 1946.

The second prototype Shetland had been allocated the serial number DX171 but was completed as a civil transport with accommodation for forty passengers. Registered G-AGVD, this aircraft was flown for the first time on September 17, 1947, but only limited flight trials were undertaken, the aircraft eventually being broken up.

The following specification relates to the first prototype Shetland without military equipment as delivered to Felixstowe.

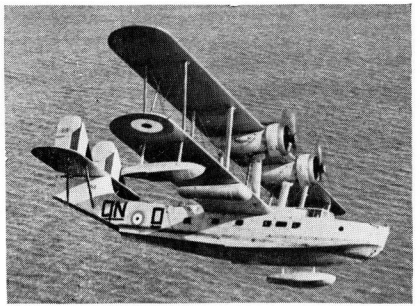
Type: *Long-range Maritime Reconnaissance Flying Boat.* **Power Plants:** *Four* 2,500 *h.p. Bristol Centaurus XI eighteen-cylinder radial air-cooled engines.* **Performance:** *Maximum speed,* 263 *m.p.h. at* 6,560 *ft.,* 258 *m.p.h. at* 10,000 *ft.; economical cruising speed,* 165 *m.p.h. at* 2,000 *ft.,* 183 *m.p.h. at* 8,000 *ft.; initial climb rate,* 700 *ft./min.; time to* 2,000 *ft.,* 2.6 *min., to* 4,000 *ft.,* 4.9 *min., to* 8,000 *ft.,* 10.6 *min., to* 14,000 *ft.,* 25.2 *min.; service ceiling,* 17,000 *ft.; range,* 4,410 *mls. at* 165 *m.p.h. at* 2,000 *ft.,* 4,323 *mls. at* 183 *m.p.h. at* 8,000 *ft.* **Weights:** *Normal loaded,* 120,000 *lb.; maximum loaded,* 125,000 *lb.* **Dimensions:** *Span,* 150 *ft.* 4 *in.; length,* 110 *ft.* 0 *in.; height,* 38 *ft.* 8 *in.; wing area,* 2,636 *sq. ft.*

SUPERMARINE STRANRAER

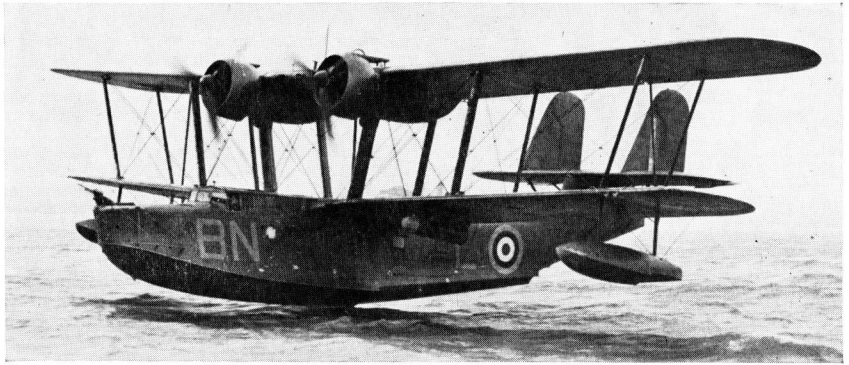
GREAT BRITAIN

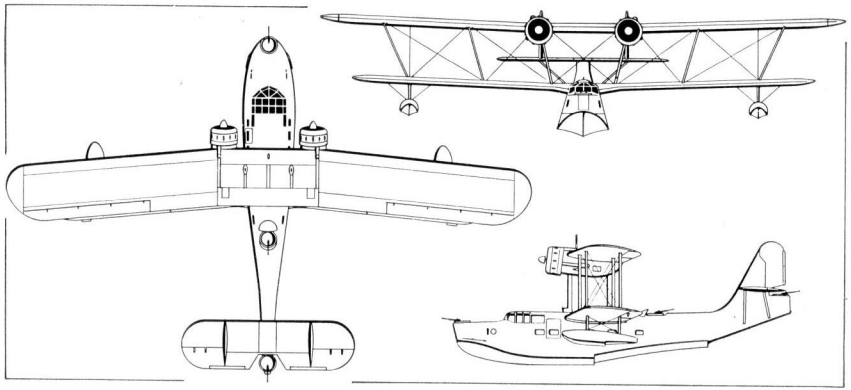
Designed to meet the requirements of specification R.24/31 which called for a twin-engined general-purpose coastal reconnaissance flying boat, the Stranraer was the last in a line of biplane flying boats produced by Supermarine and stemming from the Southampton of 1925. In fact, the first prototype (K3973) was known originally as the Southampton V, but was renamed Stranraer in August 1935, shortly after its début.

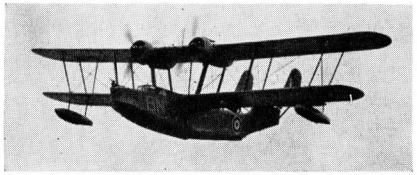
Of all-metal construction with fabric-covered wings, the Stranraer prototype was fitted with Bristol Pegasus IIIM engines driving wooden two-bladed airscrews, but production machines, seventeen of which were ordered to specification 17/35 in August 1935, received Pegasus X engines which drove three-blade Fairey-Reed metal airscrews. The Stranraer first entered service with No. 228 Squadron at Pembroke in December 1936, being operated by this unit until supplanted by Sunderlands



(Above, right) A Canadian Vickers-built Stranraer and (below) a Stranraer of No. 240 *Sqdn.*







in 1939. The Stranraer also served with Nos. 201, 209, and 240 Squadrons, but the last operational machines were finally withdrawn in the summer of 1940.

A second production order for six Stranraers placed in May 1936 was subsequently cancelled, but the type was also adopted by the R.C.A.F., and manufactured under licence by Canadian Vickers, the initial order for seven machines eventually being increased to forty. Only eight Stranraers were on R.C.A.F. strength in September 1939, production having begun in 1938, but the last Canadian-built machine was delivered in 1941, and the Stranraer served with the R.C.A.F. in the coastal reconnaissance role until finally supplanted by the Canso (Catalina) in 1943.

Type: *General-purpose Coastal Reconnaissance Flying Boat* (*Crew:* 6-7). **Power Plants:** *Two* 920 *h.p. Bristol Pegasus X nine-cylinder radial air-cooled engines.* **Armament:** *Three swivelling* 0.303-*in. Lewis machine guns in open bow, dorsal and tail positions, plus* 1,000-*lb. bomb load.* **Performance:** *Maximum speed,* 150 *m.p.h. at sea level,* 165 *m.p.h. at* 6,000 *ft.; cruising speed,* 105 *m.p.h.; initial climb rate,* 1,350 *ft./min.; climb to* 10,000 *ft.,* 10 *min.; service ceiling,* 18,500 *ft.; range,* 1,000 *mls.; endurance,* 9.6 *hr.* **Weights:** *Empty,* 11,250 *lb.; loaded,* 19,000 *lb.* **Dimensions:** *Span,* 85 *ft.* 0 *in.; length,* 54 *ft.* 10 *in.; height,* 21 *ft.* 9 *in.; wing area,* 1,457 *sq. ft.*

SUPERMARINE WALRUS

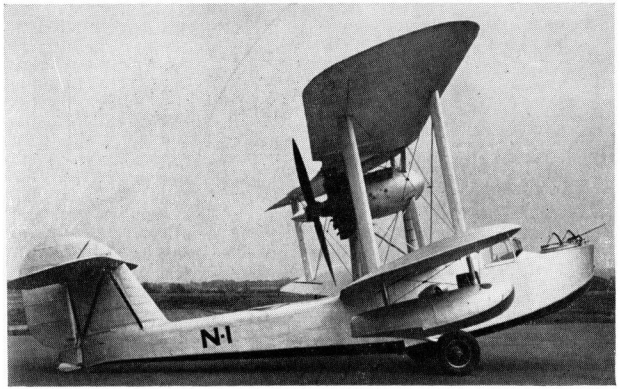
GREAT BRITAIN

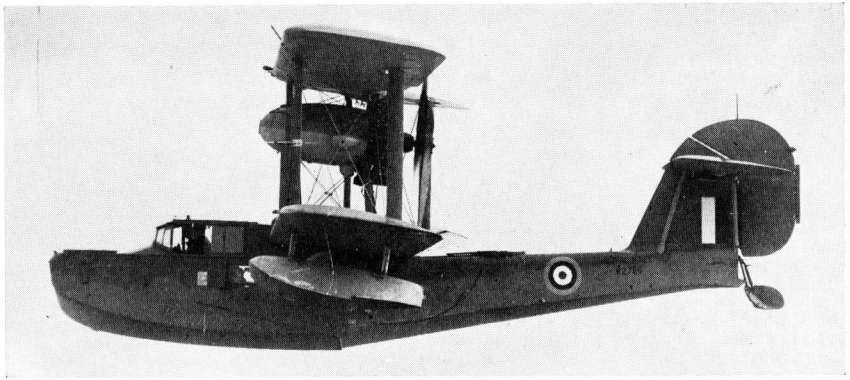
The Walrus amphibian flying boat was developed as a private venture under the name Seagull V, and was a descendant of the Seagull I of 1922 which was itself a military development of the first Supermarine amphibian, the Channel Type of 1920. Unlike earlier Seagulls, the Mark V was primarily of metal construction, the flat-sided single-step hull being of aluminium alloy, the stabilising floats being of similar construction, and the wing structure being built up on two stainless steel spars. Only the wing subsidiary structure and the ribs of the tailplane were of wood. The 635 h.p. Pegasus IIM.2 engine—the Rolls-Royce Kestrel was offered as an alternative although this power plant was never installed—was braced above the hull as a pusher, and provision was made for a Scarff gun ring in the bow and in the hull aft of the wings.

The prototype Seagull V (K4797) was flown for the first time on June 21, 1933, and twenty-four were promptly ordered by the Australian government, and, in May 1935, after evaluation by the Royal Navy's No. 702 Catapult Flight, an initial production contract for twelve aircraft was placed to specification 2/35. The amphibian was stressed for catapulting and was, in fact, to become the first aircraft of its kind in the world to be catapulted from a warship with full military load, and after very successful trials aboard H.M.S. *Nelson*, further contracts were placed to specification 37/36, these calling for an additional 204 machines, the type having been adopted as the standard A.B.R. (Amphibian-Boat-Reconnaissance) for employment on all Royal Navy ships equipped with catapults. Whereas in Australian service the designation Seagull V was retained for the amphibian, in August 1935, the name Walrus had been announced for the version ordered for the Royal Navy and the R.A.F.

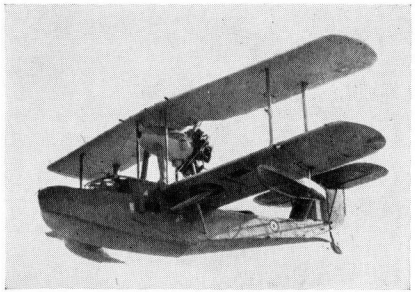
The Walrus I, as the initial production model was later to become known, entered service with the Fleet Air Arm in the summer of 1936, serving aboard battleships and

The first Seagull V, prototype of the Walrus amphibian.





(Above and below, left) A Saunders-Roe-built Walrus II (W2766) of the Royal Navy.

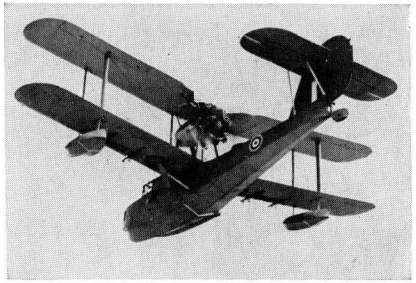


cruisers, sometimes in mixed flights with the Swordfish and, later, Seafox floatplanes, and in January 1940, all catapult units aboard warships were combined into No. 700 Squadron with a strength of forty-two Walrus amphibians and eleven Seafox and twelve Swordfish floatplanes. The Walrus also served with Nos. 711, 712, and 714 Squadrons which were joined, in May 1940, by No. 701 Squadron, one of the principal tasks of these units being the locating of commerce raiders. Other duties included spotting for naval artillery, anti-submarine and convoy patrols, and communications duties. The Walrus was even catapulted off warships to undertake bombing attacks on enemy forces, an example being the raid by a Walrus from H.M.S. *Dorsetshire* on Italian Somaliland on November 18, 1940.

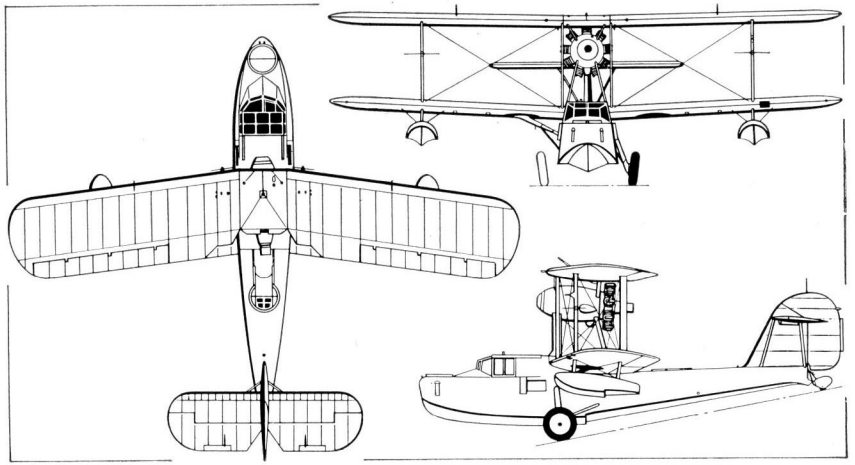
After the completion of 287 Walrus I amphibians by the parent company, production of this aircraft was transferred to Saunders-Roe which company had manufactured a further 453 machines by the time Walrus production terminated in January 1944. The

Saunders-Roe-built version was known as the Walrus II, and differed from Supermarine-built machines in having a wooden hull and a 775 h.p. Pegasus VI engine. This was the principal version of the Walrus to serve with the R.A.F., this service employing the amphibian extensively for air-sea rescue operations from 1941 onwards. The Walrus served with Nos. 269, 275, 276, 277, 278, 281 and 282 air-sea rescue squadrons in the United Kingdom, and Nos. 283, 284, 293 and 294 Squadrons in the Middle East.

The Walrus established an unrivalled reputation for reliability, operating under every imaginable climatic extreme and performing a fantastic variety of tasks, including, on one occasion, that of dive bomber during opera-



A characteristic view of the Walrus II.



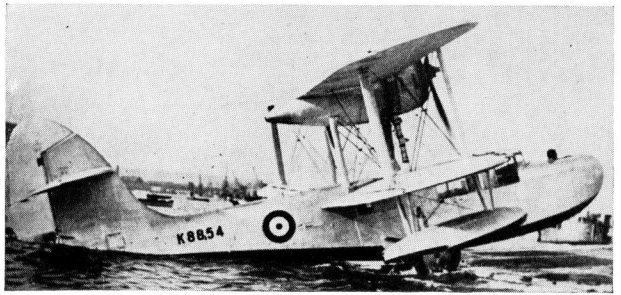
tions in the Red Sea. The Walrus's flying characteristics may best be described as sedate, but one enterprising pilot actually *looped* the amphibian! The Walrus truly provided the eyes of the Fleet and, although gradually superseded in the F.A.A. by the Sea Otter from 1944, it remained in Naval service throughout the war. It is perhaps best remembered, however, for its air-sea rescue work with the R.A.F. in the North Sea, the Channel and the Mediterranean, operating near enemy coasts and frequently alighting in mine-infested waters to effect a rescue.

The following specification relates to the wooden-hulled Walrus II.

Type: *Shipboard Observation and Shore-based Air-sea Rescue Amphibian Flying Boat.* **Power Plant:** *One 775 h.p. Bristol Pegasus VI nine-cylinder radial air-cooled engine.* **Armament:** (*Shipboard Observation*) *One 0.303-in. Vickers "K" machine gun in bow and aft positions and bombs or depth charges on universal carriers beneath lower wing.* **Performance:** *Maximum speed, 124 m.p.h. at sea level, 135 m.p.h. at 4,750 ft.; cruising speed, 95 m.p.h. at 3,500 ft.; initial climb rate, 1,050 ft./min.; time to 10,000 ft., 12.5 min.; service ceiling, 18,500 ft.; range, 600 mls. at 95 m.p.h. at 3,500 ft.* **Weights:** *Empty, 4,900 lb.; loaded, 7,200 lb.* **Dimensions:** *Span, 45 ft. 10 in.; length, 37 ft. 7 in.; height, 15 ft. 3 in.; wing area, 610 sq. ft.*

SUPERMARINE SEA OTTER — GREAT BRITAIN

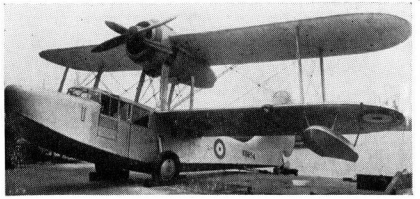
Intended as a successor to the Walrus, the Sea Otter was designed to meet the requirements of specification S.7/38, and the first prototype, the Type 309 (K8854), was flown for the first time in August 1938. This aircraft was successively modified to meet the requirements of specifications S.14/39 and S.12/40, being designated Type 347 in its final form, and production was undertaken by Saunders-Roe, although the first production Sea Otter did not fly until July 30, 1943. By comparison with the Walrus, the Sea Otter had better aerodynamic and hydrodynamic qualities, and mixed construction was employed, the single-bay folding wings having metal spars and wooden stringers with fabric covering, and the hull being all-metal. The Mercury XXX engine



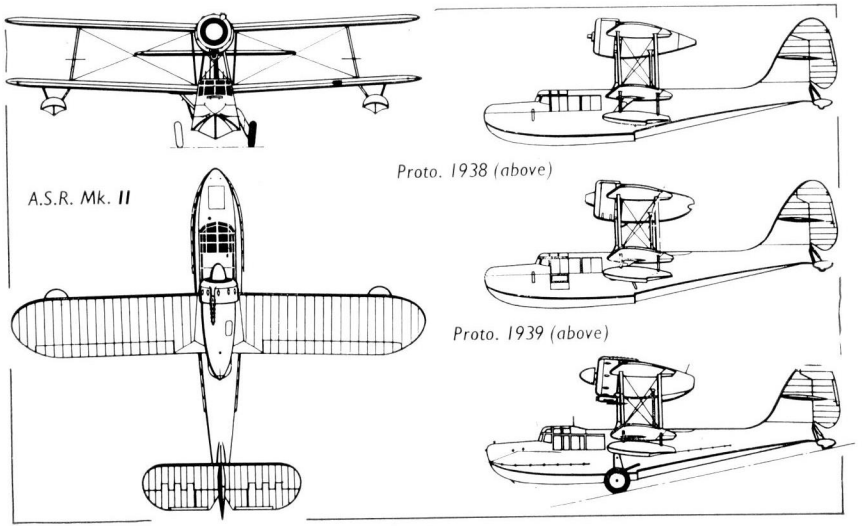
The first Sea Otter prototype (K8854) in its original form with low-slung floats.

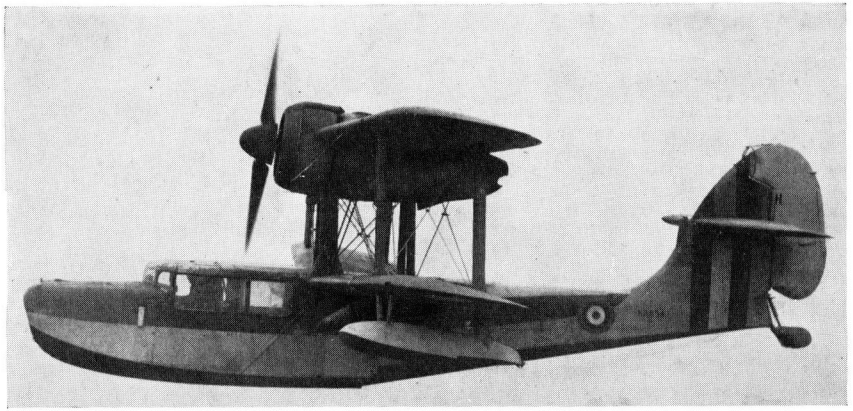
was installed as a tractor whereas the engine of the Walrus had been mounted as a pusher, and accommodation was provided for three or four crew members, defensive armament comprising three Vickers "K" guns, one of which could be mounted in the bow with the remaining two on a Scarff ring over the amidships cockpit.

The Sea Otter I entered service in November 1944 with the F.A.A.'s No. 1700 Squadron aboard the escort carrier *Khedive*, and a modified version, the Sea Otter II, for air-sea rescue, supplanted the Walrus with Nos. 276, 278, 281 and 282 Squadrons. In the Far



The first Sea Otter (K8854) with four-blade airscrew and raised floats.



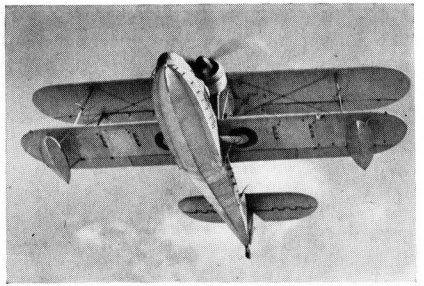


(*Above*) *The first Sea Otter* (*K*8854) *in its final form and* (*below*) *the A.B.R.Mk.I prototype* (*JM*739).

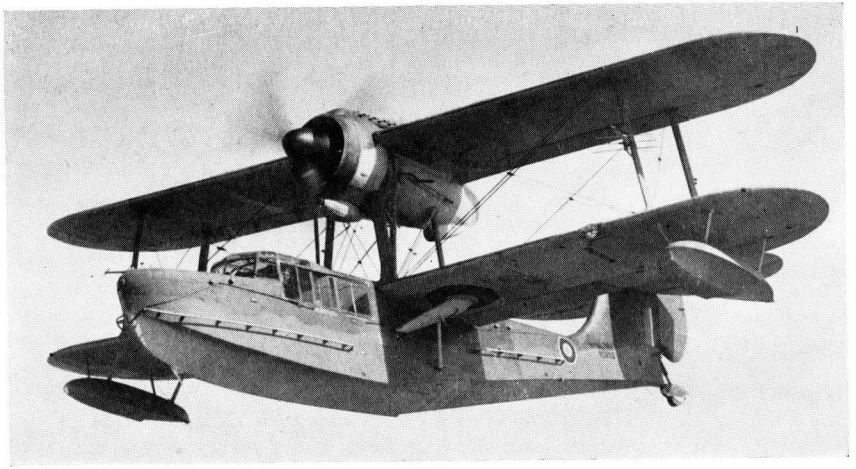
East, the Sea Otter II was operated by Nos. 1350, 1351 and 1352 Air-sea Rescue Flights, giving valuable service during the Burma campaign of 1944-45. The Mk.I version of the Sea Otter could carry bombs or depth charges on two universal carriers, one beneath each lower wing halve, and when production of this amphibian terminated in July 1946, a total of 290 machines had been delivered.

The following specification relates to the Sea Otter II.

Type: *Air-sea Rescue Amphibian Flying Boat* (*Crew:* 3-4). **Power Plant:** *One* 855 *h.p. Bristol Mercury XXX nine-cylinder radial air-cooled engine.* **Performance:** *Maximum speed,* 150 *m.p.h. at* 5,000 *ft.; cruising speed,* 100 *m.p.h. at* 5,000 *ft,; initial climb rate,* 870 *ft.! min.; climb to* 5,000 *ft.,* 6.2 *min.; service ceiling,* 16,000 *ft.; normal range,* 565 *mls.; maximum range,* 725 *mls.* **Weights:** *Empty,* 6,805 *lb.; normal loaded,* 9,250 *lb.; maximum,* 10,830 *lb.* **Dimensions:** *Span,* 46 *ft.* 0 *in.; length,* 39 *ft.* 2 *in.; height,* 16 *ft.* 2 *in.; wing area,* 610 *sq. ft.*



(*Above, right and below*) *The Sea Otter II was used extensively in the air-sea rescue role.*



C.R.D.A. CANT Z.501 GABBIANO — ITALY

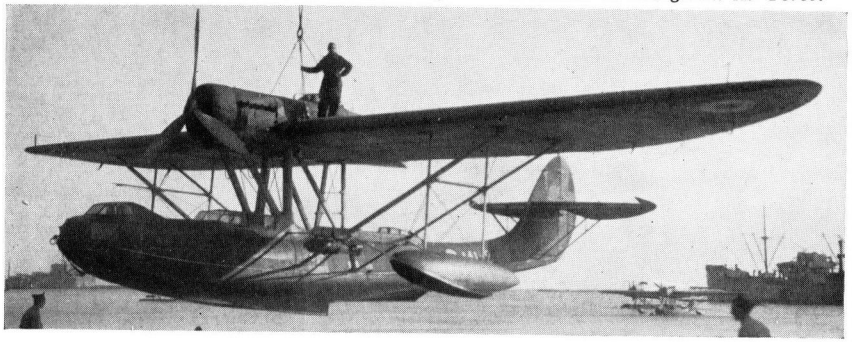
Designed by Filippo Zappata, the Cant Z.501 Gabbiano (Gull) was produced by the Cantieri Riuniti dell'Adriatico, and the prototype of this light reconnaissance-bomber flying boat was flown for the first time at Monfalcone, Trieste, in 1934. In October of that year, the Gabbiano established a World Record for seaplanes by flying from Monfalcone to Massawa, Eritrea, a distance of 2,560 miles, non-stop. Subsequently beaten by a French aircraft, the record was regained by the Gabbiano in July 1935 when it flew from Monfalcone to Berbera, Somaliland, a distance of 3,080 miles.

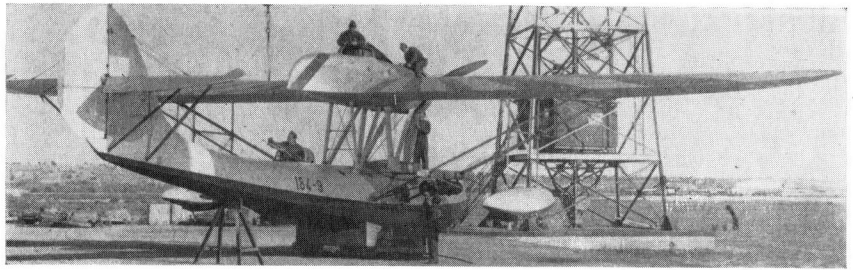
The Gabbiano first entered service with the Squadriglie da Ricognizione Marittima of the Regia Aeronautica in 1936, and when Italy entered the Second World War, in June 1940, a total of 202 flying boats of this type was in service. In its original production form, the Gabbiano carried a defensive armament of three 7.7-mm. machine guns, one mounted in an open bow turret and the others mounted in semi-enclosed positions in the engine nacelle and rear fuselage. Later, the bow cockpit for the observer was enclosed and the nose gun removed. Bomb racks were attached to the bracing struts between the hull and the wings, these carrying two 550-lb. or four 352-lb. or 220-lb. bombs. Construction was entirely of wood, the wings and control surfaces being fabric covered.

After the Armistice in 1943, the Italian Co-Belligerent Air Force continued to operate nineteen Gabbiano flying boats, and others continued in service with the Aviazione della RSI.

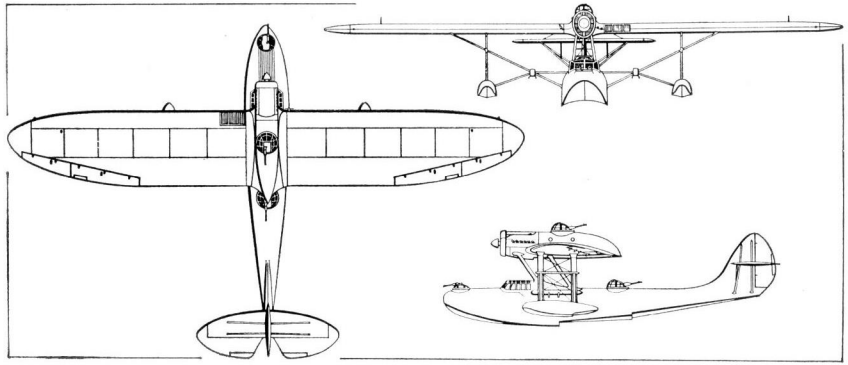
Type: *Four/five-seat Light Reconnaissance-bomber Flying Boat.* **Power Plant:** *One* 900 *h.p. Isotta Fraschini Asso XI R2 C15 twelve-cylinder Vee liquid-cooled engine.* **Armament:** *Two or three* 7.7-*mm. Breda-SAFAT machine guns and maximum bomb load of* 1,404 *lb.* **Performance:** *Maximum speed,* 171 *m.p.h. at* 8,200 *ft.,* 155 *m.p.h. at sea level; cruising speed,* 149 *m.p.h. at* 6,560 *ft.; time to* 13,120 *ft.,* 16 *min.; maximum range,* 1,490 *mls.* **Weights:** *Empty,* 8,488 *lb.; normal loaded,* 13,117 *lb.; maximum overload,* 15,542 *lb.* **Dimensions:** *Span,* 73 *ft.* 9⅞ *in.; length,* 46 *ft.* 10⅞ *in.; height,* 14 *ft.* 6 *in.; wing area,* 667.362 *sq. ft.*

*One of the Z.*501 *Gabbiano flying boats serving with the Italian Co-Belligerent Air Force.*





*A Z.*501 *of the* 184ª *Squadriglia Ricognizione Marittima at Augusta in* 1941.



AICHI H9A1

JAPAN

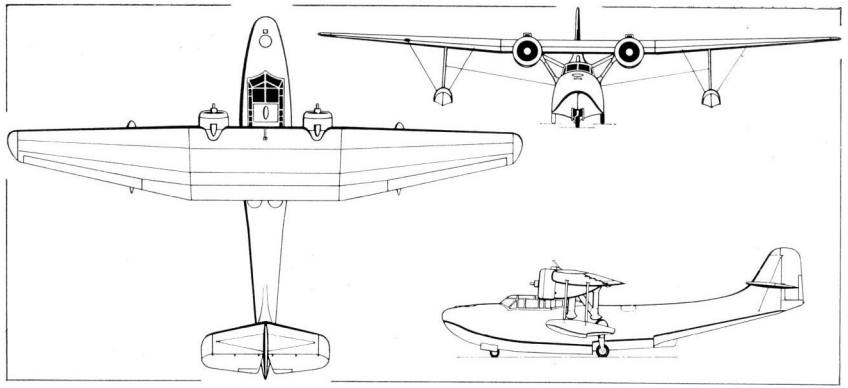
Designed as the AM-21 to meet a 13-*Shi* requirement for a trainer for the Kawanishi Type 2 Reconnaissance Flying Boat, the H9A1 flew as a prototype for the first time in 1940, and limited production began at Aichi's Eitoku plant in mid-1941 as the Type 2 Training Flying Boat, Model 11. The H9A1 featured a semi-retractable beaching chassis to facilitate the handling of the flying boat out of the water, provision was made for two practice bombs on underwing racks, and the normal crew comprised five members (pilot, co-pilot, radio-operator, observer and engineer), but three pupils could also be carried.

The H9A1 began to enter service with the J.N.A.F. in the summer of 1942, Aichi completing eleven machines during the course of the year. A further twelve flying boats of this type were completed by Aichi before production was transferred to the Nippon Hikoki K.K. in 1944, this concern building a further four machines. During the closing stages of the war in the Pacific, the H9A1 was employed primarily for anti-submarine duties, a single 7.7-mm. machine gun being mounted in bow and dorsal positions and two 550-lb. depth charges being hung under the wings.

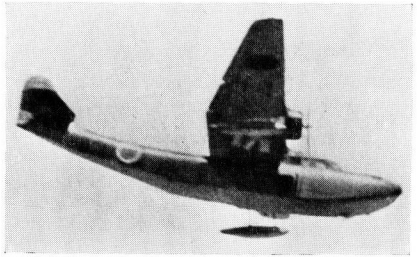
The Aichi H9A1 was one of the least known of the Japanese Navy's wartime flying boats, its existence being unknown to the Allies until the spring of 1945.

The H9A1 was not allocated an Allied code-name as its existence was unknown until the spring of 1945 when aerial reconnaissance revealed an example of this flying boat at Ibusuki.

Type: *Five/eight-seat Training and Anti-submarine Flying Boat.* **Power Plants:** *Two* 710 *h.p. Nakajima Kotobuki* 43 *nine-cylinder radial air-cooled engines.* **Armament:** (*Anti-submarine*) *Two* 550-*lb. depth charges and two* 7.7-*mm. machine guns in hand-held bow and dorsal positions.* **Performance:** *Maximum speed,* 202 *m.p.h. at* 9,810 *ft.; cruising speed,* 149 *m.p.h. at* 3,280 *ft.; climb to* 9,840 *ft.,* 10 *min.* 24 *sec.; service ceiling,* 22,250 *ft.; maximum endurance,* 8.9 *hr.* **Weights:** *Empty,* 10,803 *lb.; normal loaded,* 15,432 *lb.; maximum,* 16,689 *lb.* **Dimensions:** *Span,* 78 *ft.* $8\frac{7}{8}$ *in.; length,* 55 *ft.* $7\frac{1}{8}$ *in.; height,* 17 *ft.* $2\frac{3}{4}$ *in.; wing area,* 681.355 *sq. ft.*



The H9A1 was used for both crew training and anti-submarine patrol.

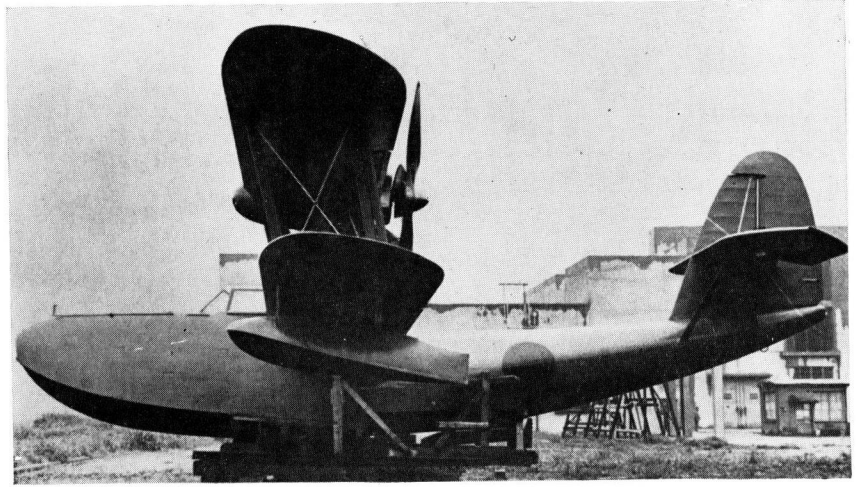


AICHI E11A1 (LAURA) — JAPAN

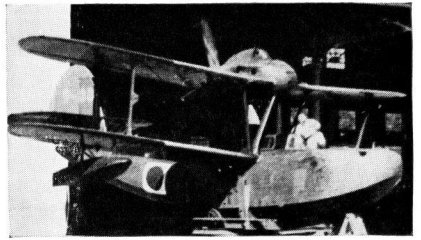
In the early 'thirties, the J.N.A.F. evolved a requirement for a night reconnaissance flying boat to be carried by light cruisers of the Japanese Navy. The requirement called for extreme slow flying capabilities and considerable endurance, and it was intended that the flying boat would serve as a spotter for destroyer forces using wolf-pack tactics against enemy surface vessels. The first type to be accepted for this role was the 9-*Shi* Aichi AB-12, or E10A1, fifteen examples of which were built between 1934 and 1937 as the Type 96 Reconnaissance Seaplane.

The approaching obsolescence of the E10A1 resulted in an 11-*Shi* requirement for a replacement, and this was met by an extensive redesign of the earlier aircraft, the Aichi AB-14, or E11A1, which entered production in 1937 as the Type 98 Reconnaissance Seaplane. Like its predecessor, the E11A1 was a three-seat biplane with a single Hiro Type 91 engine installed as a pusher, and carrying a defensive armament of a single 7.7-mm. machine gun on a ring-type mounting in the bow. The E11A1 flew for the first time in June 1937, and seventeen had been built when production terminated in 1940, these supplanting the E10A1s and being used primarily for short-range night reconnaissance tasks.

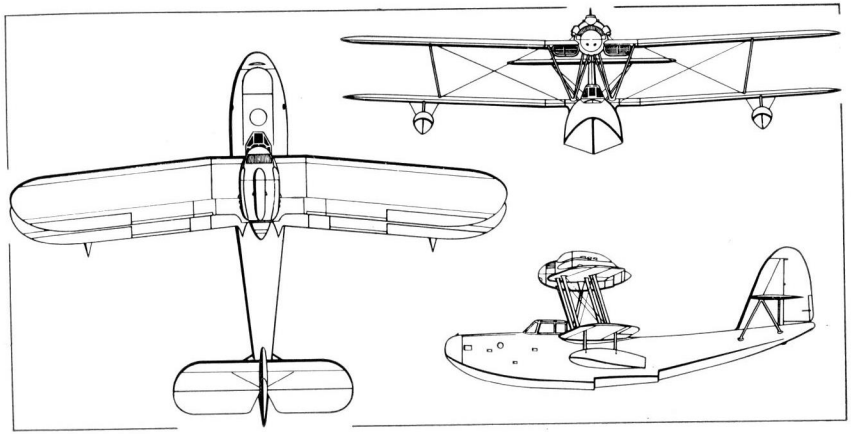
Seventeen E11A1 three-seat night reconnaissance flying boats were built prior to the Pacific War.



Type: *Three-seat Night Reconnaissance Flying Boat.* **Power Plant:** *One 620 h.p. Hiro Type 91 twelve-cylinder liquid-cooled engine.* **Armament:** *One 7.7-mm. machine gun in open bow position.* **Performance:** *Maximum speed, 135 m.p.h. at 7,875 ft.; patrol speed, 81 m.p.h. at 3,280 ft.; time to 9,840 ft., 18 min. 32 sec.; service ceiling, 14,520 ft.: range, 1,284 mls. at 81 m.p.h.; maximum endurance, 15 hr.* **Weights:** *Empty, 4,248 lb.; loaded, 7,269 lb.* **Dimensions:** *Span, 47 ft. 6½ in.; length, 35 ft. 1¾ in.; height, 18 ft. 0½ in.*

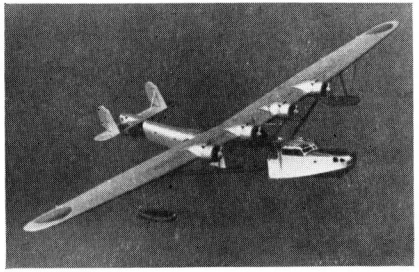


The E11A1 was originally intended to serve as a spotter for destroyer forces using wolf-pack tactics against enemy surface vessels.



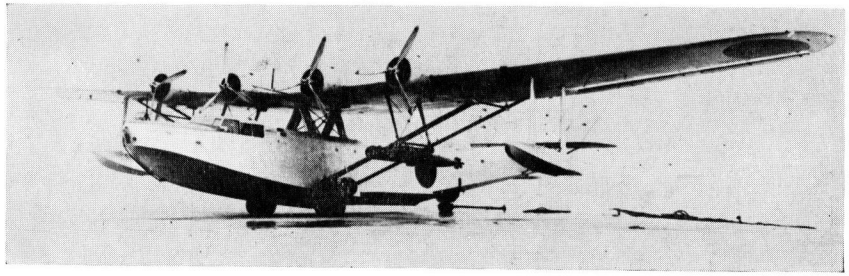
KAWANISHI H6K1-H6K5 (MAVIS) JAPAN

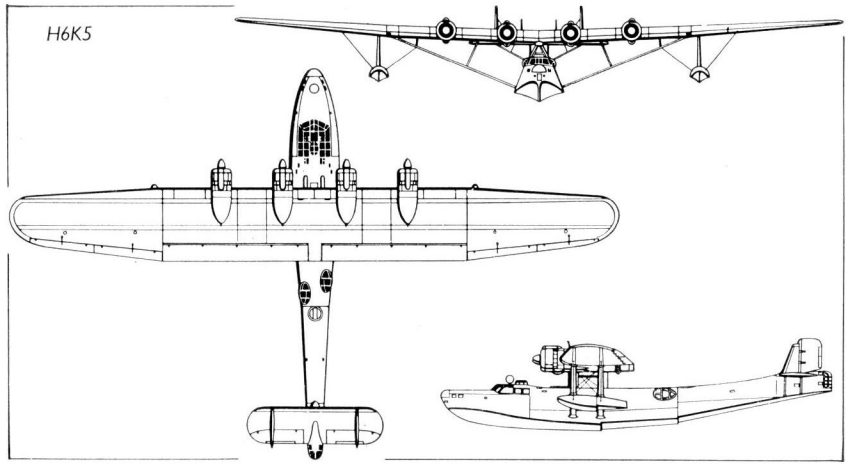
When Japanese forces launched the Pacific War only one type of long-range maritime reconnaissance flying boat was in first-line service with the Japanese Navy, the Kawanishi Type 97, a contemporary of the Sunderland with a parasol wing raised above the hull on inverted Vee struts and braced by parallel struts attached low on the hull and running to half-span. Owing much to contemporary French and American design techniques, the Type 97 was of all-metal construction and stemmed from a 9-*Shi* specification which, issued in 1934, had called for a four-engined monoplane flying boat possessing exceptional range capabilities. From the outset it was planned to install a power-operated dorsal turret of French design, and five prototypes were ordered.



Powered by four 840 h.p. Nakajima Hikari 2 radial engines, the first prototype was flown in July 1936, and immediately after the first flight the forward hull step was moved aft by 19.7 in. The second and fourth prototypes, which had joined the test programme before the end of the year, featured enlarged vertical tail fins, ailerons of increased span, and the fairings fore and aft of the dorsal turret eliminated, and the first, third and fourth prototypes were later re-engined with Mitsubishi Kinsei 43 engines of 1,000 h.p., and, designated H6K1 Type 97 Flying Boat, these

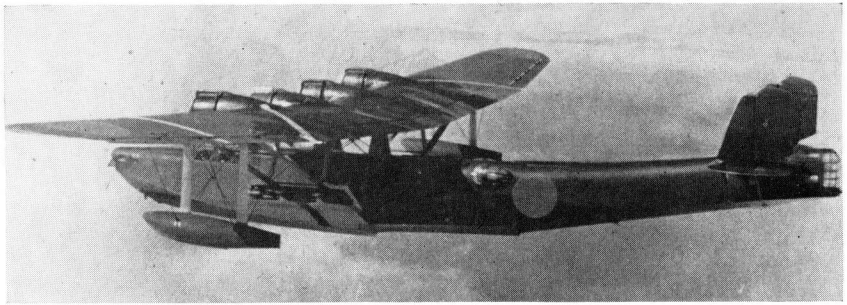
(*Below*) *The H6K2, or Type 97 Flying Boat Model 11 and* (*above, left*) *the H6K2-L transport.*





entered service with the Japanese Navy in January 1938 after successfully completing official acceptance trials. The fifth aircraft was, in fact, the production prototype and the first H6K2, or Type 97 Flying Boat Model 11. Powered by Kinsei 43 engines, ten H6K2s were built, including the prototype, the third and fourth being modified as experimental transports with all military equipment removed. The next two aircraft were built from the ground up as transports under the designation H6K3, these later being redesignated H6K2-L. The H6K2-L had accommodation for sixteen passengers and served on civil and military routes, eighteen machines being delivered to Japan Air Lines for scheduled services to Saipan, Palau and other points in the West Pacific.

The first major production version of the aircraft for the Japanese Navy was the H6K4 Type 97 Flying Boat Model 22. Retaining the Kinsei 43 engines, this version had the power-operated dorsal turret replaced by two beam blisters which, staggered in the upper decking of the hull, each contained one hand-held 7.7-mm. machine gun. Another 7.7-mm. gun was provided in an open position in the bow, and a fourth could be mounted in an open dorsal position aft of the beam blisters. A hand-held 20-mm. cannon was installed in a non-powered tail turret, and the normal bomb load consisted of two 1,764-lb. bombs or twelve 132-lb.



The last production version of the Type 97 flying boat, the H6K5.

bombs, and two 1,764-lb. torpedoes could be attached to the bracing struts as an alternative load.

In August 1941, 1,070 h.p. Kinsei 46 engines replaced the earlier Kinsei 43s. Empty weight had risen from the 22,795 lb. of the H6K2 to 25,809 lb., and normal loaded weight from 35,274 lb. to 37,479 lb., maximum overload being 50,706 lb. The maximum speed of the Kinsei 46-powered H6K4 was 211 m.p.h. at 13,120 ft., and maximum overload range was 3,728 miles, endurance being twenty-seven hours.

Sixty-six H6K4 flying boats were in operational service with the Japanese Navy when the Pacific War began, twenty-four of these being with the Yokohama Air Corps, twenty-four with the Toko Air Corps, three with the Yokosuka Air Corps, and the remainder with the Sasebo Air Corps. Dubbed *Mavis* by the Allies, the Kawanishi flying boat was extremely active in the South-West Pacific, both in the reconnaissance bomber and transport roles, a number of Kinsei 46-powered machines having been completed as H6K4-L transports, but lacking armour protection for the crew and engines, or self-sealing fuel tanks, it was extremely vulnerable to fighter attack, forcing its gradual withdrawal from daylight operations as the war progressed. In an attempt to rectify some of the shortcomings of the aircraft, the H6K5 Type 97 Flying Boat Model 23 was placed in production in August 1942. This variant was powered by Kinsei 53 engines offering 1,300 h.p. for take-off and 1,200 h.p. at 9,840 ft. No attempt was made to increase defensive armament, although the open bow position was replaced by a turret housing a similar 7.7-mm. gun immediately aft of the flight deck.

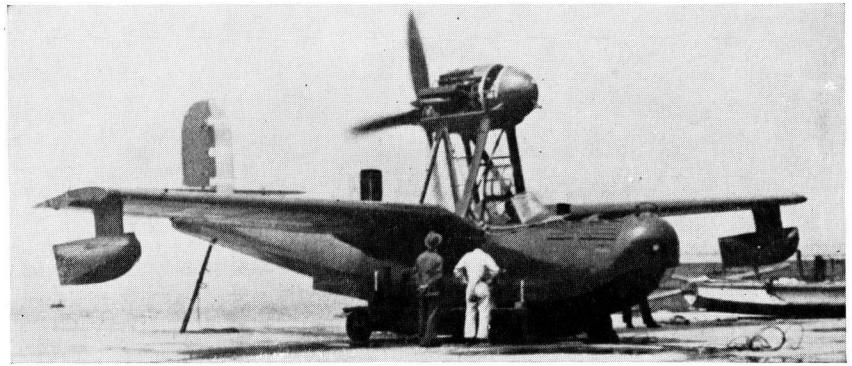
Relatively few H6K5 flying boats had been completed when production terminated in 1943 in favour of the H8K series, and during the course of that year the majority of the H6K flying boats were withdrawn from first-line duties and converted as transports. A total of 217 Type 97 flying boats of all types was produced.

The following specification relates to the H6K5.

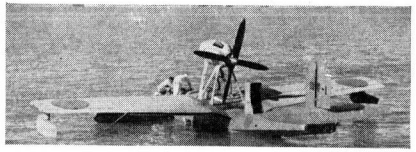
Type: *Long-range Maritime Reconnaissance Bomber Flying Boat (Crew: 9).* **Power Plants:** *Four 1,300 h.p. Mitsubishi Kinsei 53 fourteen-cylinder radial air-cooled engines.* **Armament:** *Four 7.7-mm. machine guns in forward and aft dorsal turrets and beam blisters, and one 20-mm. cannon in tail turret, plus two 1,764-lb., four 1,100-lb. or 550-lb., or twelve 132-lb. bombs or two 1,764-lb. torpedoes.* **Performance:** *Maximum speed, 239 m.p.h. at 19,685 ft.; cruising speed, 161 m.p.h. at 13,120 ft.; time to 16,400 ft., 13 min. 23 sec.; service ceiling, 31,365 ft.; normal range, 3,070 mls.; maximum range, 4,210 mls.; maximum endurance, 26 hr.* **Weights:** *Empty, 27,290 lb.; normal loaded, 38,580 lb.; maximum loaded, 50,706 lb.* **Dimensions:** *Span, 131 ft. 2¾ in.; length, 84 ft. 1 in.; height, 20 ft. 6¾ in.; wing area, 1,829.86 sq. ft.*

KAWANISHI E11K1 — JAPAN

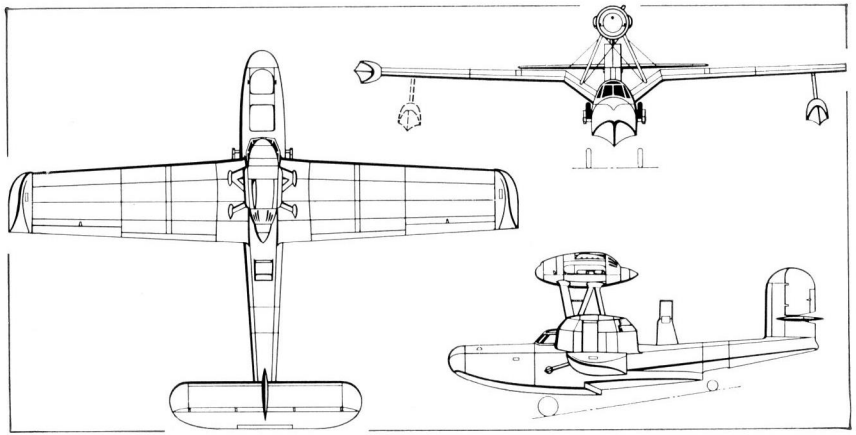
The Kawanishi E11K1 three-seat reconnaissance flying boat was designed to meet the same 11-*Shi* requirement to which the Aichi E11A1 was evolved, this calling for a small special reconnaissance aircraft for launching from cruisers of the Japanese Navy. The E11K1 displayed a number of advanced features. Its cantilever monoplane wing was of gull form, and the wing-tip floats were retractable. The liquid-cooled Hiro Type 91 liquid-cooled engine was carried above the hull on splayed N-struts, and the second proto-



type featured a retractable beaching chassis. Trials with the E11K1 began in 1937, but the J.N.A.F. selected the Aichi E11A1 for producton, and the two E11K1 prototypes eventually entered service with the J.N.A.F. as Type 96 Transport Flying Boats, serving in the utility transport role during the war years.



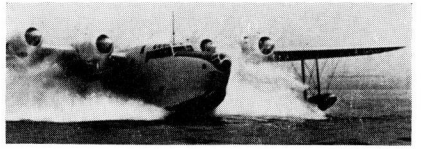
Type: *Three-seat Utility Transport Flying Boat.* **Power Plant:** *One* 750 *h.p. Hiro Type* 91 *twelve-cylinder liquid-cooled engine.* **Armament:** *One* 7.7-*mm. machine gun in open bow position.* **Performance:** *Maximum speed,* 144 *m.p.h.; maximum cruising speed,* 129 *m.p.h.; patrol speed,* 81 *m.p.h. at* 3,280 *ft.; time to* 9,840 *ft.,* 22 *min.; service ceiling,* 13,780 *ft.; maximum endurance,* 8.4 *hr.* **Weights:** *Empty,* 5,996 *lb.; normal loaded,* 7,275 *lb.; maximum,* 8,510 *lb.* **Dimensions:** *Span,* 53 *ft.* 1⅛ *in.; length,* 38 *ft.* 8¾ *in.; height,* 14 *ft.* 5¼ *in.; wing area,* 409.029 *sq. ft.*

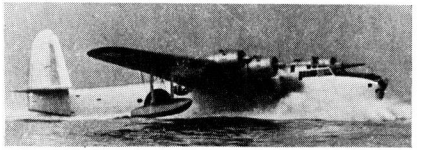


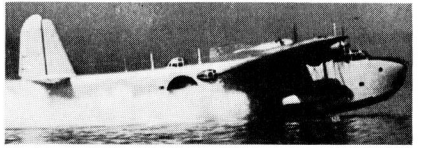
KAWANISHI H8K1-H8K4 (EMILY) JAPAN

The Kawanishi Type 2 Flying Boat was undoubtedly one of the finest Japanese warplanes to see operational service during the Second World War. Possessing an exceptional performance, it was, in fact, the fastest flying boat to serve with any of the combatants, and its hydrodynamic qualities were superior to those of British, American or German contemporaries. It was also exceptionally well armoured and carried a heavy defensive armament, and it was treated with the greatest respect by Allied fighter pilots.

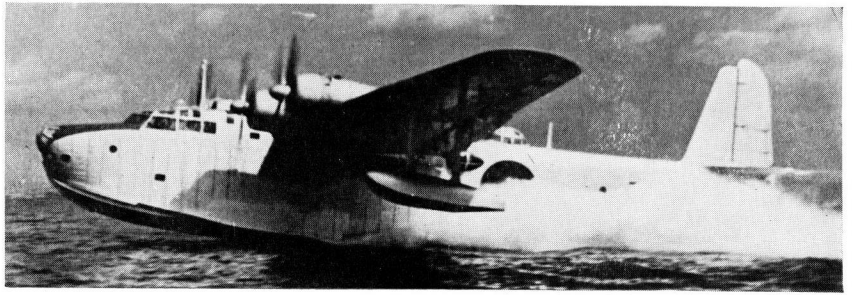
Designed in 1938 as a Type 97 replacement, the flying boat was developed to meet a 13-*Shi* specification which demanded a thirty per cent increase in speed over that of the earlier flying boat, and a fifty per cent greater range, combined with greater manoeuvrability. To meet these stringent demands, Kawanishi produced an extremely clean, high-wing canti-

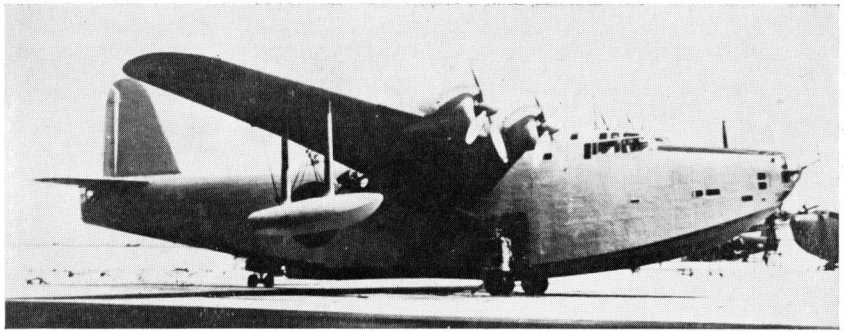






(Right and below) The original H8K1 prior to the introduction of a deeper hull to improve characteristics on the water.



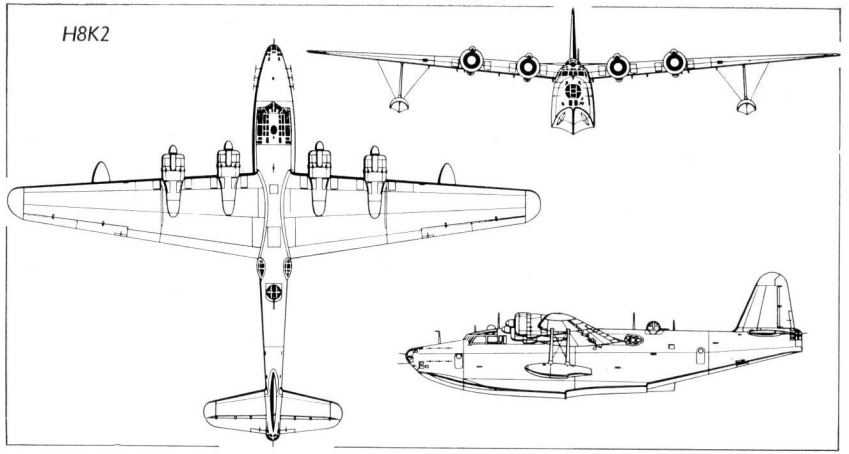


The H8K1 with deeper hull, modified planing bottom and enlarged vertical fin.

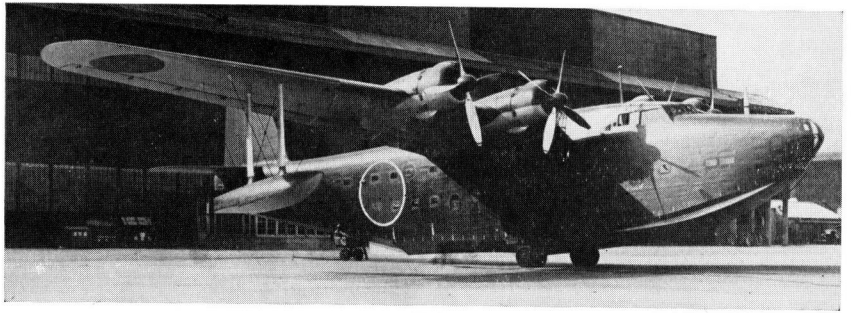
lever monoplane which was originally to have featured retractable stabilising floats, although these were abandoned in favour of fixed floats in order to save weight before the completion of the first prototype. Completed on December 31, 1940, and designated H8K1, the first prototype was powered by four 1,530 h.p. Mitsubishi MK4A Kasei 11 radials, and had provision for a defensive armament of five 20-mm. cannon and three 7.7-mm. machine guns.

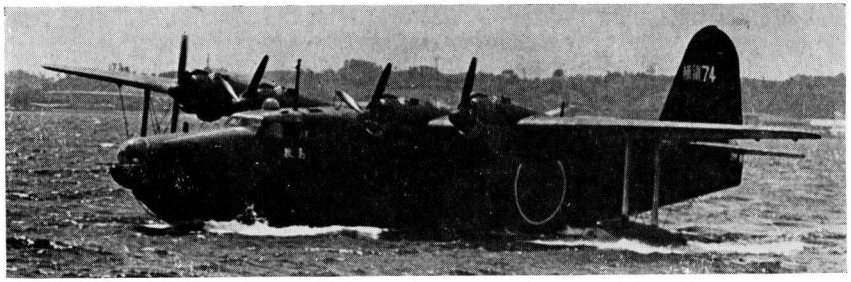
By contrast with its precedessor, the H8K1 proved to be extremely unstable on the water and prone to porpoising. Numerous changes were made to the contours of the planing bottom in order to eradicate the flying boat's shortcomings, one modification being an increase in the depth of the hull from 14 ft. 9 in. to 16 ft. 4¾ in. The similarly-powered second and third H8K1 prototypes embodied further modifications, the latter featuring an enlarged vertical tail fin. Eventually water handling of the flying boat was brought to an acceptable standard, and the type was finally accepted for production in 1941 as the Type 2 Flying Boat Model 11.

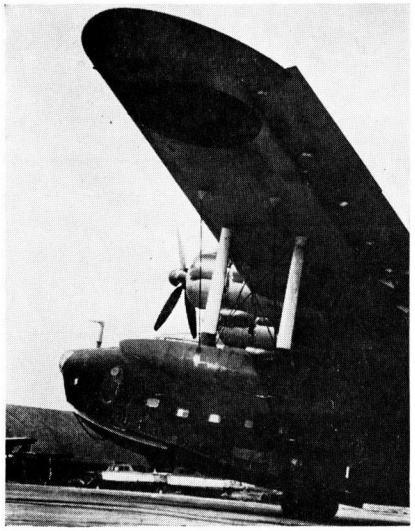
The H8K1 made its operational début with a night attack on Oahu Island in March 1942. The H8K1 flying boats were based at Watje, in the Marshall Islands, some two thousand nautical miles east of Pearl Harbour, and as even the very considerable range of the Kawanishi was inadequate to make the round trip without refuelling, the flying boats rendezvoused with a refuelling submarine at French Frigate Island, some 650 miles from Hawaii. Unfortunately for the three flying boats, Oahu proved to be covered by thick cloud and their attack was abortive. The H8K1 had empty and normal loaded weights of 34,176 lb. and 54,013 lb., and maximum loaded weight was 68,343 lb. Maximum speed was 251 m.p.h. at 13,120 ft., and cruising speed was 184 m.p.h. at the same altitude, range being 2,933



(*Below*) *The H8K2-L Seiku transport, thirty-six examples of which were built during* 1943–45.







The H8K2-L (above and left) provided accommodation for twenty-nine to sixty-four passengers.

miles. Defensive armament comprised two 7.7-mm. machine guns in the nose, two similar guns firing from beam blisters, a 20-mm. gun in a dorsal turret and a second 20-mm. weapon in the tail turret, and normal offensive load comprised eight 550-lb. bombs or two 1,764-lb. torpedoes.

The eighteenth Type 2 Flying Boat was fitted with Kasei 22 engines of 1,850 h.p. as the first H8K2 Type 2 Model 12, this variant featuring a defensive armament of no less than five 20-mm. cannon and one 7.7-mm. machine gun, and maximum speed was boosted to 290 m.p.h., making the flying boat, by now dubbed *Emily* by the Allies, an extremely formidable aircraft indeed. Manufactured at Kawanishi's Konan plant, near Kobe, the H8K2 had fully protected fuel tanks, effective armour protection for the crew members, and surface search radar, the Yagi aerials for which sprouted from the bow. The H8K2-L *Seiku* (Clear Sky) was a transport variant in which defensive armament was reduced to one 20-mm. and one 13-mm. gun, and accommodation

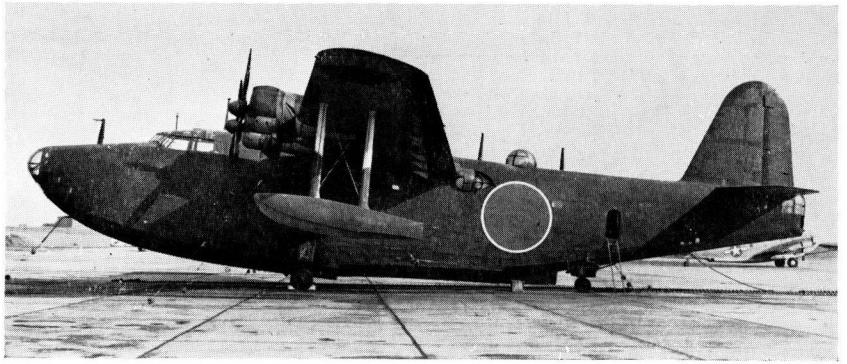
provided for twenty-nine to sixty-four passengers. The *Seiku* had been developed from the original H8K1 prototype which, after initial trials, had been fitted with Kasei 22 engines and converted for the transport role as the H8K1-L. A total of thirty-six H8K2-L *Seiku* transports was produced between 1943 and 1945.

An experimental variant of the Type 2 Flying Boat was the H8K3 which featured retractable wingtip floats and a retractable dorsal turret, defensive armament being, like that of late production H8K2s, five 20-mm. cannon and four 7.7-mm. machine guns. Only two examples of the H8K3 were built, these later being re-engined with Kasei 25b engines and redesignated H8K4. Output of the Type 2 Flying Boat at the Konan plant dropped during the last year of the war owing to the priority given to fighter production, and when the end of the Pacific War stopped further work, a total of 167 Type 2 Flying Boats had been completed.

The following specification relates to the H8K2.

Type: *Long-range Maritime Reconnaissance Bomber Flying Boat (Crew:* 10). **Power Plants:** *Four* 1,850 *h.p. Mitsubishi Kasei* 22 *fourteen-cylinder radial air-cooled engines.* **Armament:** *One* 20-*mm. cannon in bow, dorsal and tail turrets and two beam blisters, and four hand-held* 7.7-*mm. machine guns firing laterally, plus eight* 550-*lb. bombs or two* 1,764-*lb. torpedoes.* **Performance:** *Maximum speed,* 290 *m.p.h. at* 16,400 *ft.; cruising speed,* 184 *m.p.h. at* 13,120 *ft.; time to* 13,120 *ft.,* 7 *min.* 56 *sec., to* 16,400 *ft.,* 10 *min.* 12 *sec.; service ceiling,* 28,740 *ft.; maximum range,* 3,800-4,447 *mls.* **Weights:** *Empty,* 40,520 *lb.; normal loaded,* 54,013 *lb.; maximum overload,* 71,650 *lb.* **Dimensions:** *Span,* 124 *ft.* 8 *in.; length,* 92 *ft.* 3½ *in.; height,* 30 *ft.* 0 *in.; wing area,* 1,722.23 *sq. ft.*

The H8K2 (below) was one of the most formidable flying boats employed by any of the combatants.



YOKOSUKA H5Y1 (CHERRY)

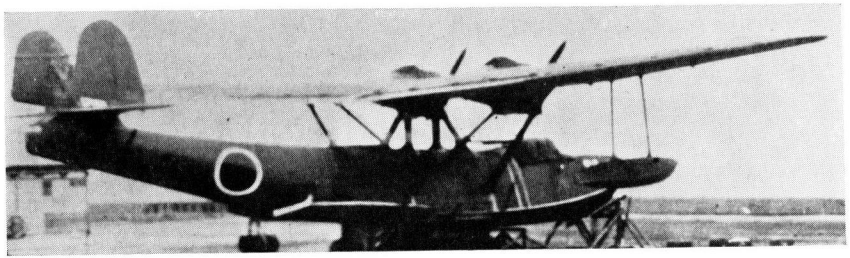
JAPAN

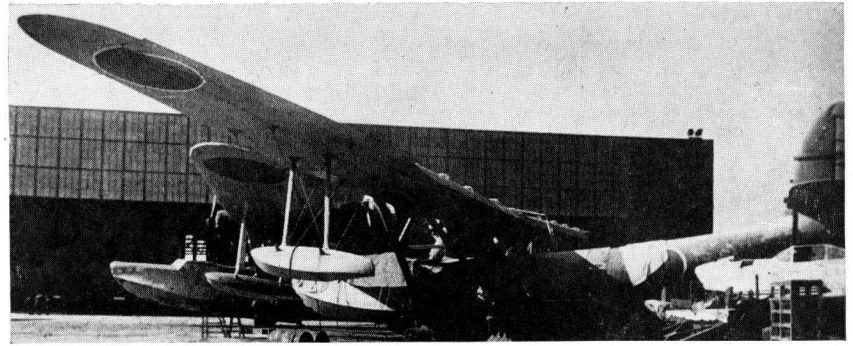
To meet a 9-*Shi* specification for a medium-sized maritime reconnaissance flying boat in which low initial cost and ease of maintenance were important requirements, the 1st Naval Air Technical Arsenal at Yokosuka designed a twin-engined parasol-wing aircraft, the H5-Y1, which was essentially a scaled-down version of Kawanishi's H6K Type 97 series of four-engined flying boats. The 11th Naval Air Arsenal at Hiro was given the responsibility of building two prototypes, these being completed during 1936.

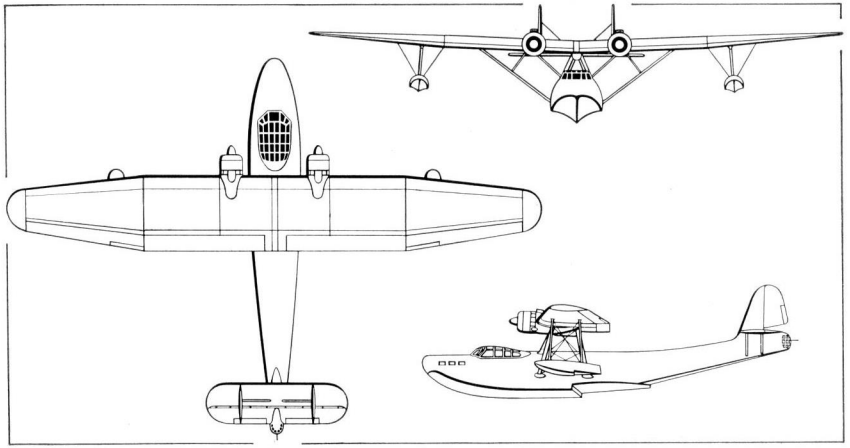
The H5Y1 had been designed to offer a performance comparable with that of contemporary four-engined flying boats, but it was soon found to be underpowered, and structural shortcomings delayed development, and it was not until 1938 that the type was accepted for production as the Type 99 Flying Boat, Model 11. Power was provided by two 1,200 h.p. Mitsubishi MK1A Shinten radials, armament comprised two 7.7-mm. machine guns, and construction was all-metal. Production deliveries began in 1939, but so poor was the performance of the aircraft that manufacture had been terminated by the end of the year, only ten H5Y1 flying boats being delivered.

Dubbed *Cherry* by the Allies, the H5Y1 was considered unsuitable for operational use by the Japanese Navy and was relegated to second-line duties such as communications and transport, although some were used for coastal anti-submarine patrol during the early part of the Pacific War, these carrying two 550-lb. bombs.

Type: *Maritime Reconnaissance Flying Boat* (*Crew:* 6). **Power Plants:** *Two* 1,200 *h.p. Mitsubishi MK1A Shinten fourteen-cylinder radial air-cooled engines.* **Armament:** *One or two* 7.7-*mm. machine guns firing laterally from windows in bow and one* 7.7-*mm. gun in tail turret, plus two* 550-*lb. bombs.* **Performance:** *Maximum speed,* 188 *m.p.h. at* 3,280 *ft.; time to* 9,840 *ft.,* 24 *min.; service ceiling,* 17,320 *ft.; maximum range,* 2,980 *mls.; maximum endurance,* 26 *hr.* **Weights:** *Empty,* 15,554 *lb.; loaded,* 25,353 *lb.* **Dimensions:** *Span,* 103 *ft.* 6½ *in.; length,* 67 *ft.* 4 *in.; height,* 22 *ft.* 0 *in.; wing area* 1,159.272 *sq. ft.*

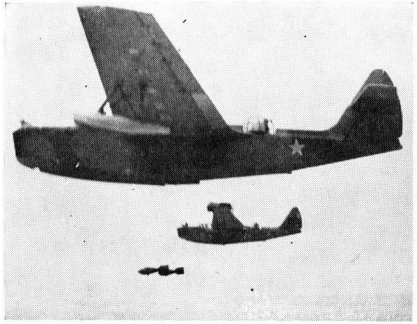






BERIEV MBR-2 (BE-2)

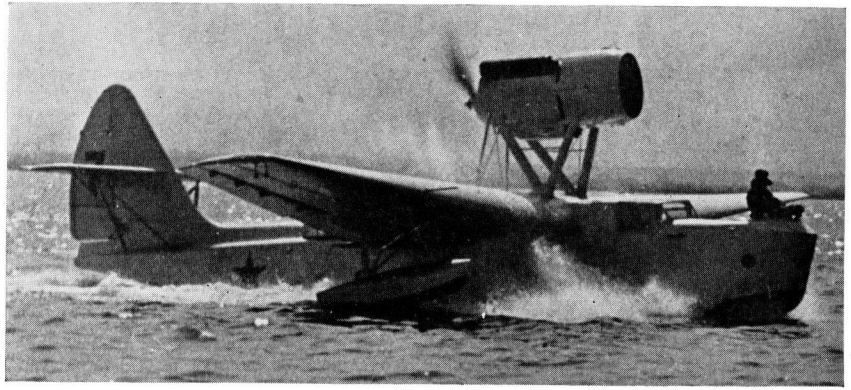
SOVIET UNION

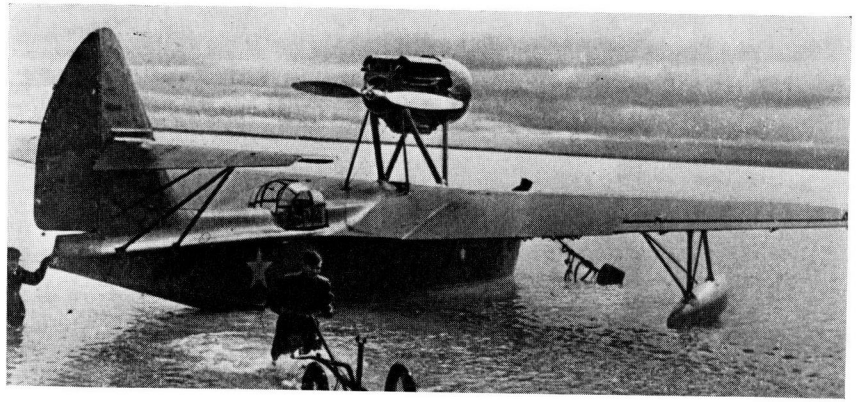


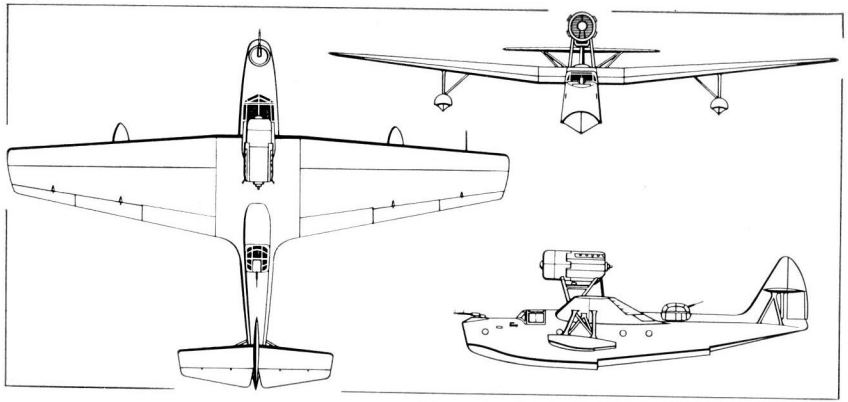
One of the most successful of the Soviet Union's designers of water-borne aircraft was G. M. Beriev whose progeny were virtually the only flying boats of Russian design to be employed extensively by the VVS-VMF during the war years. Perhaps Beriev's most successful pre-war design and certainly that manufactured in the largest quantities was the MBR-2, or Be-2, which was tested for the first time in 1931. The MBR-2 (Morskii Blizhnii Razvedchik or Naval Short-range Reconnaissance) had a metal wing and a two-step wooden hull. It possessed exceptionally fine hydrodynamic qualities, could be operated from skis or wheels, and had good load-lifting capabilities.

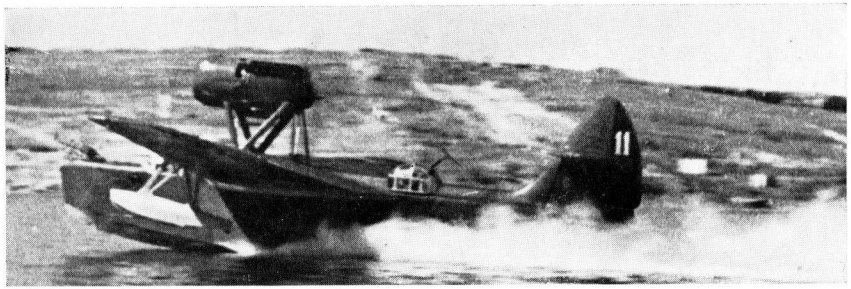
The initial production model of the MBR-2,

First flown in 1931, *the MBR-2 remained in production until* 1942, *more than* 1,500 *being built.*









which began to appear in service with the VVS-VMF in 1933, was powered by a single 680 h.p. M-17 twelve-cylinder liquid-cooled Vee engine derived from the German BMW VI and mounted above the hull on two sets of "N" struts. Five crew members were carried, and open bow and dorsal gun positions were provided. With a 1,180-lb. fuel load, the MBR-2 possessed a range of 597 miles, and maximum speed was 137 m.p.h. Fuel tankage was eventually increased, and an internal fuel load of 1,852 lb. raised maximum range to 932 miles. The MBR-2bis differed from the initial model in having an M-34 engine rated at 860 h.p. for take-off and 850 h.p. at 6,560 ft., and both MBR-2 and MBR-2bis were built in substantial numbers until 1942, more than 1,500 machines being delivered to the VVS-VMF.

In addition to maritime reconnaissance, the MBR-2 served in the transport role, and a civil version was built for use on internal routes. Designated MP-1, the transport model provided accommodation for eight passengers, and established a number of international records. The well-known Russian woman pilot, P. D. Osipenko, established several altitude class records between May 22 and May 25, 1937, including 22,997 feet with a 1,000-kg. load, 24,952 feet with a 500-kg. load, and 29,083 feet without a useful load, the last-mentioned altitude record remaining unbeaten for twenty-three years.

The open dorsal gun position was supplanted on later production machines by a manually-operated turret, and a maximum offensive load of 660 lb. could be carried on underwing racks. The following specification relates to the MBR-2bis.

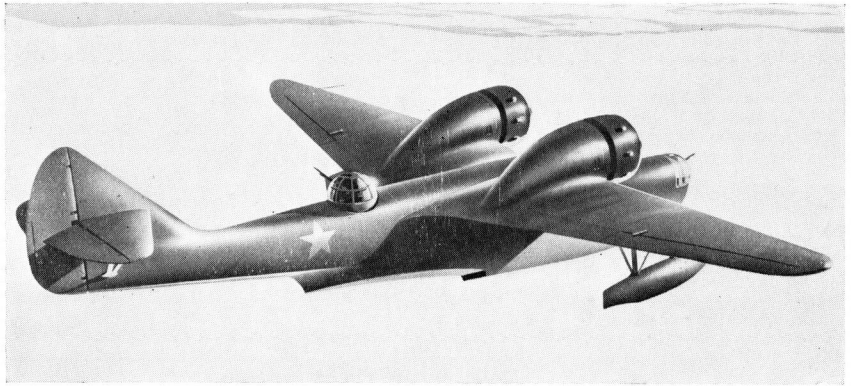
Type: *Four/five-seat Short-range Reconnaissance Flying Boat.* **Power Plant:** *One* 860 *h.p. M-34 twelve-cylinder Vee liquid-cooled engine.* **Armament:** *One* 7.62-*mm. machine gun in open bow and turreted dorsal positions, and a* 660-*lb. load of bombs, mines or depth charges on underwing racks.* **Performance:** *Maximum speed,* 154 *m.p.h. at* 6,560 *ft.; cruising speed,* 121 *m.p.h.; maximum range (without bombs),* 870 *mls., (with external fuel tanks),* 1,243 *mls., (with a* 660-*lb. bomb load),* 746 *mls.; service ceiling,* 19,690 *ft.* **Weights:** *No details available.* **Dimensions:** *Span,* 43 *ft.* 11½ *in.; length,* 30 *ft.* 2¼ *in.*

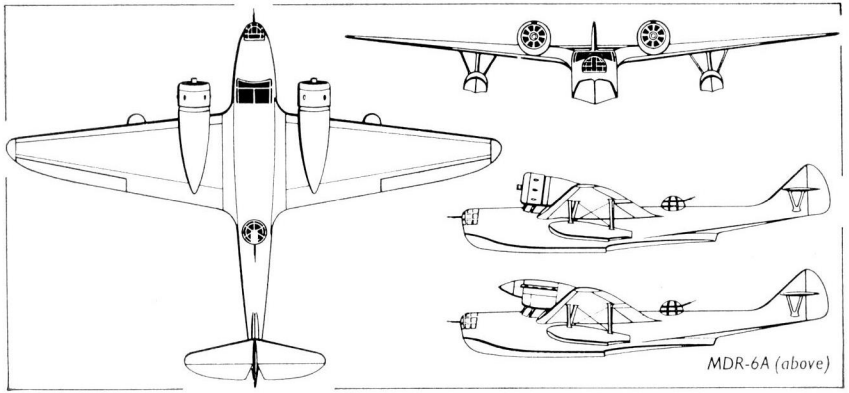
BERIEV MDR-6 (BE-4)

SOVIET UNION

During the Soviet Union's second five-year plan (1933-37), the Soviet Navy established a requirement for a long-range reconnaissance flying boat. Tupolev's design bureau evolved the ANT-27 which, given the official designation MDR-4 (Morskii Dalynii Razvedchik or Naval Long-range Reconnaissance), began trials early in 1934, but the first prototype crashed in April of that year, and the second prototype was destroyed during the state acceptance trials in September 1935. Despite the serious shortcomings of the MDR-4, a series of fifteen aircraft of this type were built pending the availability of a more efficient type, these entering service with the Soviet Navy in April 1936.

In the meantime, G. M. Beriev, designer of the highly successful MBR-2, had begun work on a very much more advanced long-range reconnaissance flying boat, the Be-4 or MDR-6, a shoulder-wing monoplane carrying five crew members and featuring manually-operated nose and dorsal turrets. The MDR-6 began flight trials in 1938, series production commencing during the following year. The initial production model was powered by two 1,100 h.p. M-63 nine-cylinder radials derived from the Wright Cyclone 9, and these were mounted above the wing leading edges at a very marked angle of attack, giving the MDR-6 a characteristic nose-down attitude in level flight. The MDR-6 proved exceptionally successful in service, and various offensive loads were carried on racks under the inboard wing sections, including bombs, depth charges and torpedoes.





MDR-6A (above)

During 1941, a new version of the flying boat was evolved, the MDR-6A with Klimov M-105A twelve-cylinder liquid-cooled engines. Although possessing a similar maximum power rating to the M-63 radials, the M-105As resulted in a 43 m.p.h. increase in maximum speed and a 10,000-ft. increase in practical ceiling, despite an increase in loaded weight of more than 1,500 pounds. Further development resulted in the MDR-6B of 1944. This model had 1,260 h.p. M-105 engines, and maximum loaded weight was no less than 26,454 lb., an increase of almost 10,000 lb. over that of the MDR-6A. The MDR-6B attained a maximum speed of 236 m.p.h. at unspecified weight and altitude.

The MDR-6 was built in substantial numbers during 1939-44, and served with the air components of Russia's Northern, Baltic, Black Sea, and Pacific Fleets. The MDR-6A and B versions remained in service with the A-VMF well into the 'fifties, receiving the NATO appellation of *Mug*.

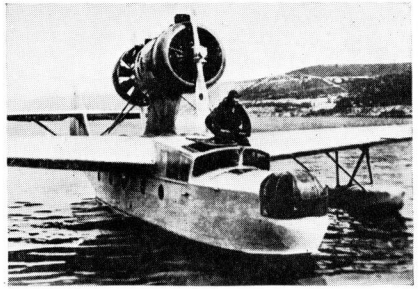
The following specification relates to the M-63-powered MDR-6, figures in parentheses referring to the MDR-6A.

Type: *Five-seat Long-range Reconnaissance and Bomber Flying Boat.* **Power Plants:** *Two* 1,100 *h.p. M-63 (M-105A) nine-cylinder radial air-cooled (twelve-cylinder inverted-Vee liquid-cooled) engines.* **Armament:** *One* 7.62-*mm. ShKAS machine gun in each of manually-operated nose and dorsal turrets, plus six* 220-*lb., or two* 550-*lb. or one* 1,100-*lb. bombs, or mines, depth charges or torpedos on underwing racks.* **Performance:** *Maximum speed,* 224 (267) *m.p.h. at* 16,400 *ft.; economical cruising speed,* 136 (142) *m.p.h. at sea level; maximum ceiling.* 29,530 (39,370) *ft.* **Weights:** *Loaded,* 14,991 (16,534) *lb.* **Dimensions:** *Span,* 64 *ft.* 11½ *in.; length,* 48 *ft.* 2¼ *in.*

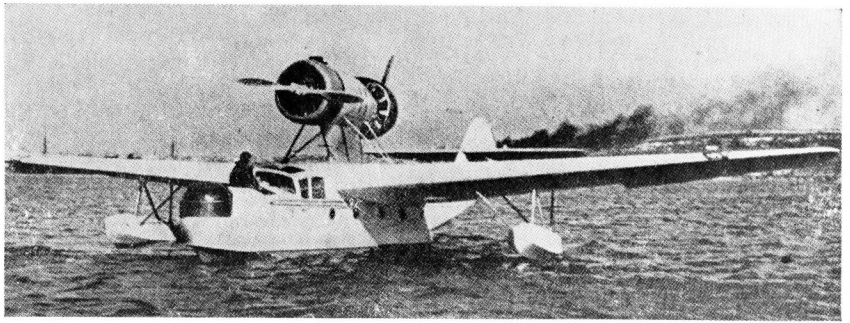
CHETVERIKOV ARK-3

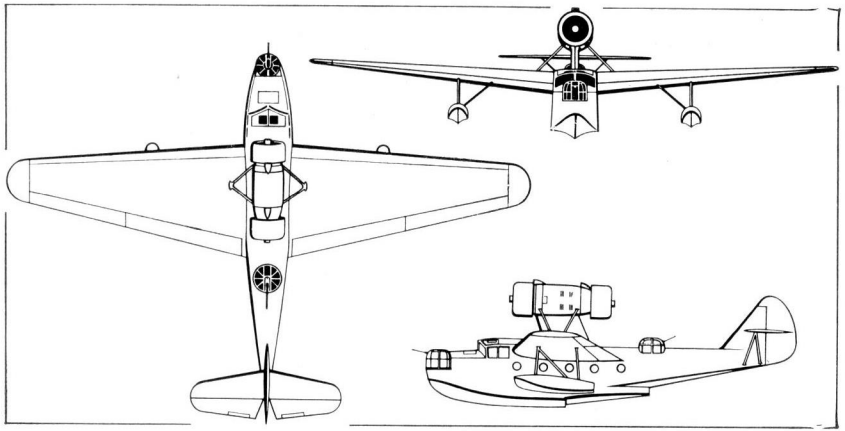
SOVIET UNION

During the mid-'thirties, the VVS-VMF began to consider the adoption of aircraft designed specifically for use under arctic conditions. Few airfields or strips had been constructed in the Arctic areas of the Soviet Union, and a requirement was conceived for a multi-purpose flying boat suitable for use in the northernmost regions of Russia and capable of fulfilling the reconnaissance-bomber and transport roles. To meet this requirement, I. V. Chetverikov evolved a medium-range flying boat of mixed construction and powered by two 700 h.p. M-25 nine-cylinder radial air-cooled engines which were mounted on a pylon above the hull, the forward engine driving a tractor airscrew and aft engine driving a pusher airscrew. The advantages of this arrangement included the ability to cruise on the power of one engine without serious asymmetrical effects. Designated ARK-3, the flying boat flew for the first time in 1935, and was placed in limited



The ARK-3 was designed specifically for use in the Arctic, and was used on a small scale during the war for convoy protection in the Far North.





production for the VVS-VMF. Simultaneously, a commercial transport version with accommodation for twelve passengers was evolved.

The production ARK-3 was powered by two 750 h.p. M-25V radials driving two-bladed airscrews. The hull was of metal construction, the wings had metal spars with wooden ribs and metal covering, and the tail assembly was of wood, all control surfaces being fabric-covered. Five crew members were normally carried, and defensive armament comprised a single 7.62-mm. machine gun in each of two manually-operated bow and dorsal turrets. Racks were provided beneath the inboard wing sections for two 1,100-lb. or four 550-lb. bombs, or an equivalent load of mines or depth charges. In April 1937, the ARK-3 established an international weight-to-altitude record for its class by lifting a 1,000-kg. payload to 30,052 ft.

The ARK-3 was used on a small scale during the Second World War for convoy protection in the Far North.

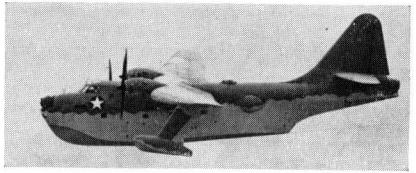
Type: *Five-seat Reconnaissance-bomber and Transport Flying Boat.* **Power Plants:** *Two 750 h.p. M-25V nine-cylinder radial air-cooled engines.* **Armament:** *One 7.62-mm. machine gun in each of bow and ventral manually-operated turrets, plus a 2,220-lb. load of bombs, mines or depth charges.* **Performance:** *Maximum speed, 199 m.p.h.; economical cruising speed, 112 m.p.h. at 3,280 ft.; maximum cruising speed, 173 m.p.h. at 4,920 ft.; maximum range at economical cruising, 932 mls.; service ceiling, 27,890 ft.* **Weights:** *Normal loaded, 11,574 lb.* **Dimensions:** *Span, 65 ft. 3½ in.; length, 47 ft. 6¾ in.*

BOEING XPBB-1

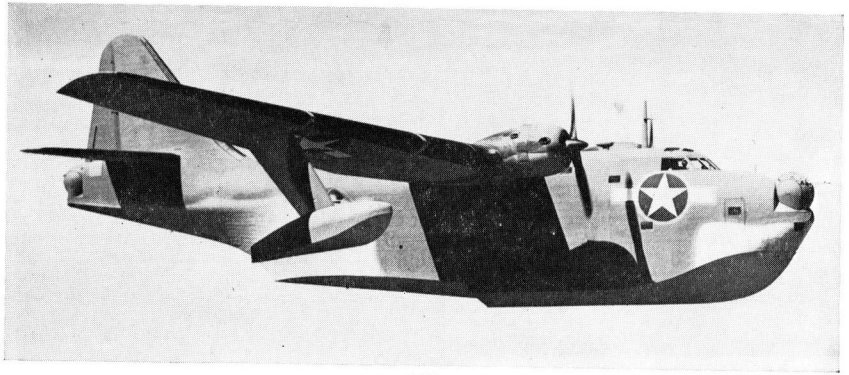
U.S.A.

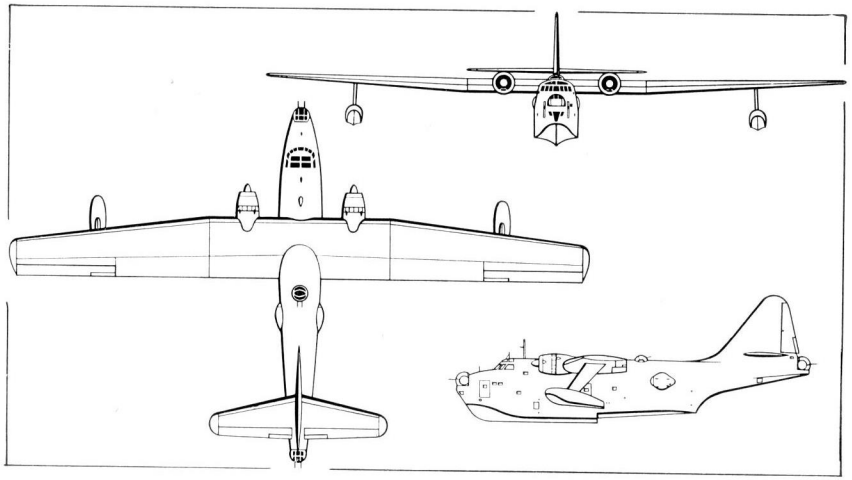
During the early stages of the Second World War the appearance of submarines and surface raiders in both the Atlantic and Pacific oceans indicated that the U.S. Navy would need a very long-range patrol bomber suitable for locating and destroying enemy raiders. To meet this requirement, Boeing designed the Sea Ranger, the largest wartime twin-engined flying boat, and a prototype was ordered on June 29, 1940, as the XPBB-1. Flown for the first time on July 5, 1942, the XPBB-1 was capable of staying airborne for seventy-two hours, and provision was made for up to twenty 1,000-lb. bombs. Maximum fuel capacity was 5,737 Imp. gal., and defensive armament comprised twin 0.5-in. guns in nose and tail turrets and a similar armament in two barbettes in the fuselage sides.

A plant was built at Renton. Washington, specifically for the production of the PBB-1, and fifty-seven flying boats of this type were on order for the U.S. Navy when military strategy dictated a change in emphasis from seaplanes to landplanes, and orders for the PBB-1 were cancelled, the Renton factory subsequently producing the B-29 Superfortress



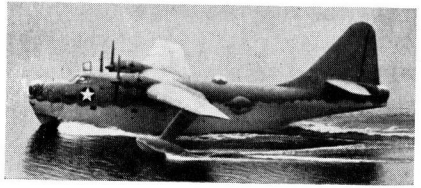
The XPBB-1 was the largest twin-engined flying boat built and flown by any combatant.





for the U.S.A.A.F. The wing of the Superfortress was similar to that of the XPBB-1.

The XPBB-1 was capable of staying airborne for seventy-two hours.

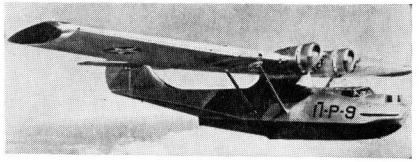


Type: *Long-range Maritime Reconnaissance-bomber Flying Boat.* **Power Plants:** *Two* 2,300 *h.p. Wright R-3350-8 Cyclone eighteen-cylinder radial air-cooled engines.* **Armament:** *Eight* 0.5-*in. machine guns in bow, waist and tail positions, plus a maximum bomb load of* 20,000 *lb.* **Performance:** *Maximum speed,* 228 *m.p.h. at* 14,200 *ft.,* 214 *m.p.h. at sea level; maximum cruising speed,* 158 *m.p.h.; patrol speed,* 127 *m.p.h.; initial climb rate,* 980 *ft./min.; service ceiling,* 22,400 *ft.; normal range,* 4,245 *mls., maximum,* 6,300 *mls.* **Weights:** *Empty,* 41,531 *lb.; loaded,* 62,006 *lb.; maximum overload,* 101,130 *lb.* **Dimensions:** *Span,* 139 *ft.* 8½ *in.; length,* 94 *ft.* 9 *in.; height,* 34 *t.* 2 *in.; wing area,* 1,826 *sq. ft.*

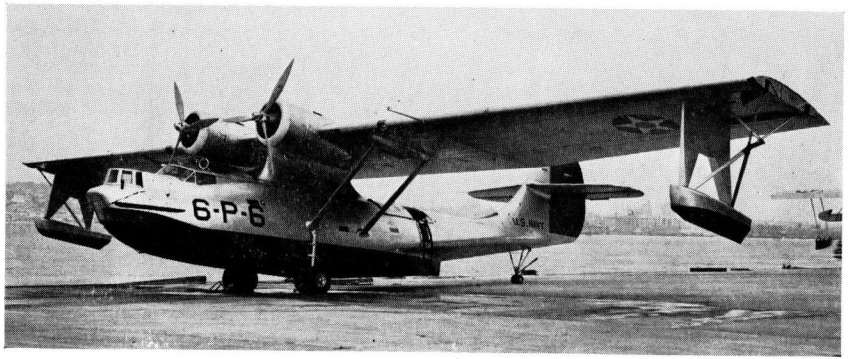
CONSOLIDATED PBY-1—PBY-6A CATALINA U.S.A.

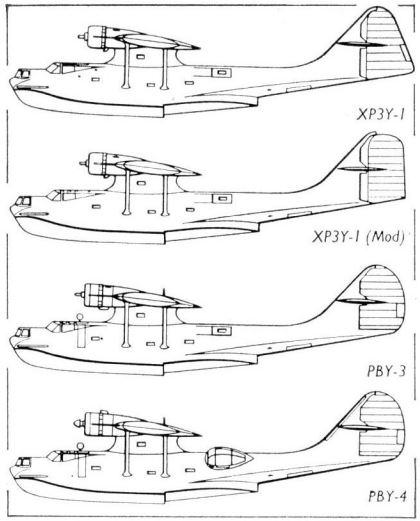
The Consolidated Model 28 Catalina was probably the most successful flying boat ever developed by any nation. In continuous production for ten years in a variety of models and built in larger numbers than all other flying boats combined, the Catalina served in every part of the world and with more than a half-dozen air arms during the Second World War.

The Catalina, or Consolidated Model 28, stemmed from the XP3Y-1 which had been ordered by the U.S. Navy on October 28, 1933. Owing much to earlier Consolidated flying boats, the first of which, the XPY-1, had been completed in January 1929, the XP3Y-1 was an exceptionally clean all-metal monoplane which, at the time of its début, was unique in featuring retractable wingtip stabilising floats. Such was the performance revealed by the XP3Y-1 when it commenced flying trials on March 28, 1935 that the U.S. Navy broadened its requirement from that of a patrol to a patrol-bomber flying boat. The XP3Y-1 was initially powered by a pair of 825 h.p. Pratt and Whitney R-1830-54 Twin Wasps, and in October 1935, the prototype was returned to Consolidated for the installation of 900 h.p. R-1830-64s similar to those called for in the production model, sixty



(*Below*) *The PBY-1 which entered service in October* 1936, *and* (*above right*) *the PBY-2.*



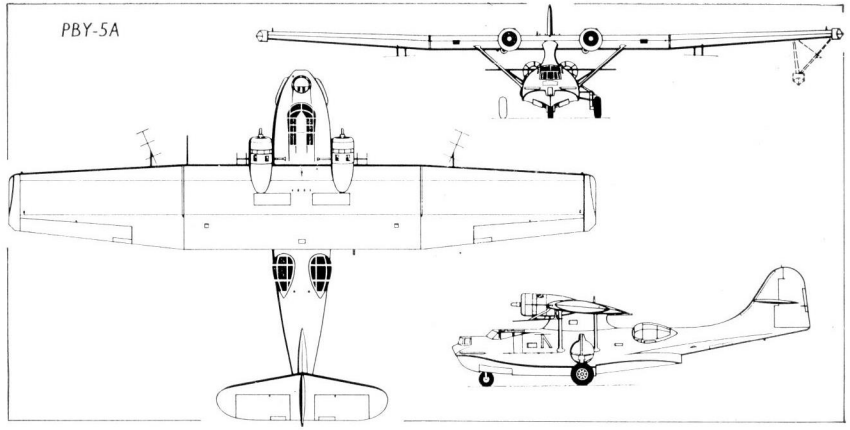


examples of which had been ordered on June 29, 1935, under the designation PBY-1. When the XP3Y-1 re-emerged on May 19, 1936, as the XPBY-1, it featured entirely redesigned vertical tail surfaces in addition to the more powerful engines. The original triangular vertical tail surfaces with which the XP3Y-1 had first flown had given place to larger, redesigned surfaces at an early flight test stage, but these had not proved entirely satisfactory, and the new curved surfaces introduced by the XPBY-1 were to be retained until the appearance of the PBY-5 model four years later.

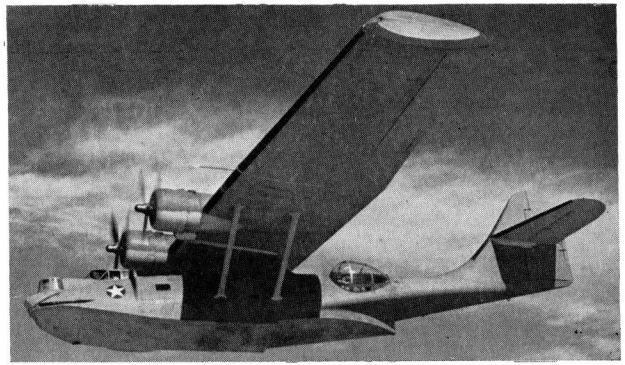
After completing its trials, the XPBY-1 flew non-stop from Norfolk, Virginia, to San Diego, California, via Coco Solo, a distance of 3,443 miles, to establish a new International Distance Record. The first of the sixty PBY-1s was delivered to U.S. Navy Squadron VP-11F on October 5, 1936, by which time a further fifty aircraft had been ordered as PBY-2s, these embodying minor equipment changes, deliveries to the U.S. Navy beginning in May 1937. Sixty-six further aircraft ordered on November 27, 1936, as PBY-3s switched to 1,000 h.p. R-1830-66 Twin Wasps, while a further thirty-three machines ordered a year later, on December 18, 1937, had 1,050 h.p. R-1830-72 Twin Wasps as PBY-4s. The first PBY-4 was tested in May 1938, and was externally similar to its predecessors, but the second and subsequent thirty-one aircraft featured transparent beam blisters enclosing the gunners' positions and supplanting the sliding hatches.

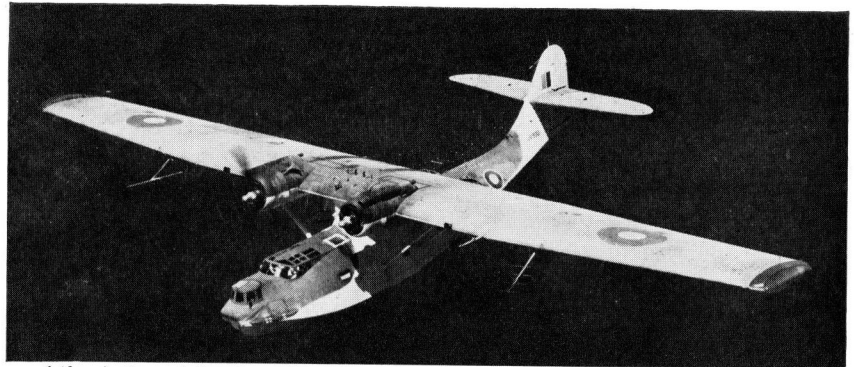
The flying boat had been dubbed Catalina by its manufacturers, although this name was not to be officially adopted by the U.S. Navy until October 1, 1941, and during 1938 the Soviet Union purchased three flying boats of this type, together with a manufacturing licence, and eighteen Consolidated technicians accompanied the aircraft to Russia to assist in establishing a production line for the Catalina at Taganrog. The Russian-built version, which was powered by M-62 radial engines and was designated GST, appeared late in 1939, and several hundred flying boats of this type were subsequently built for the Soviet Navy.

The success of the Model 28 Catalina soon aroused the interest of the British Air Ministry, and one example of the flying boat (Model 28-5) was purchased for evaluation, this being flown across the Atlantic in July 1939 and delivered to the Marine Aircraft Experimental

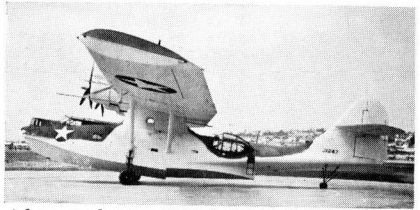


Establishment at Felixstowe as P9630. With the outbreak of war, fifty aircraft were ordered for R.A.F. Coastal Command, and these were to be designated Catalina I in British service. The Catalina I was essentially similar to the U.S. Navy's PBY-5, two hundred examples of which were ordered on December 20, 1939, specifically for the Neutrality Patrol. The PBY-5, the first example of which was delivered





(Above) One of the ninety-five PBY-5s supplied to the R.A.F. as Catalina IVAs.



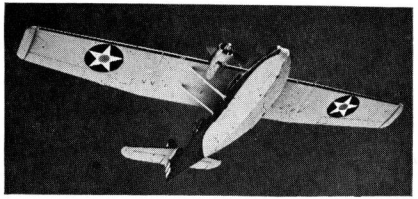
A late production PBY-5 originally intended for delivery to the R.A.F. as a Catalina IVA but transferred to the U.S. Navy. The R.A.F. serial number (JX247) was retained.

on September 18, 1940, featured redesigned vertical tail surfaces and R-1830-82 Twin Wasp engines rated at 1,200 h.p. for take-off and 1,050 h.p. at 5,700 feet, although later production PBY-5s, like all subsequent variants of the Catalina, switched to the R-1830-92 engine which, offering the same take-off power, was rated at 1,050 h.p. at 7,000 feet. The Catalina Is produced in parallel or the R.A.F. had the similar R-1830-S1C3-G Twin Wasp engine, but differed from the U.S. Navy's PBY-5s in defensive armament which, in the British flying boat, comprised a single 0.303-in. Vickers machine gun in the bow, twin Vickers guns in each of the beam blisters, and a sixth Vickers gun firing through a tunnel aft of the hull step.

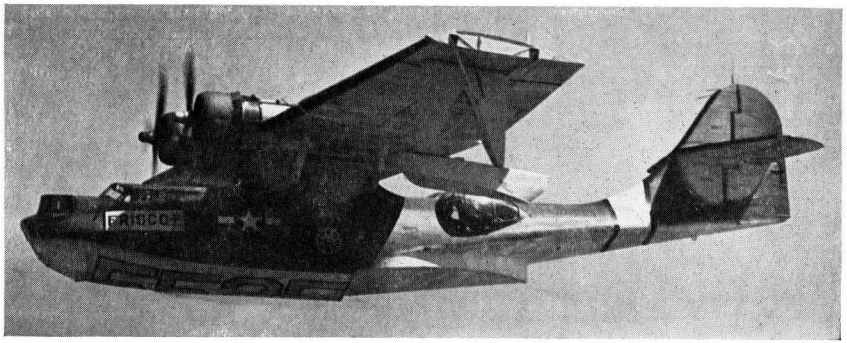
In 1940, the French Purchasing Commission had ordered thirty Model 28-5MF flying boats for the French Navy, although France had collapsed before any delivery was effected, eighteen had been ordered for the R.A.A.F., and a further forty-eight had been ordered by the Dutch government for use in the East Indies. In the event, thirty-six of the PBY-5 flying boats ordered by the Dutch had been delivered to the East Indies by the time this

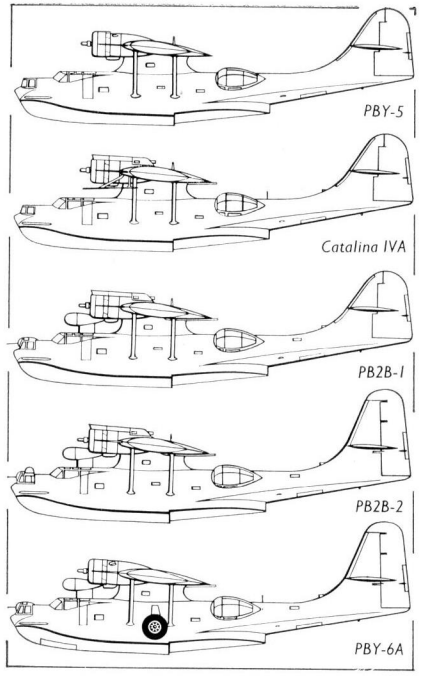
territory was overrun by Japanese forces, nine escaping to form the equipment of No. 321 Squadron in Ceylon on July 1, 1942. The remaining twelve aircraft on the Dutch order were supplied as PBY-5A amphibians, and these patrolled the Indian Ocean until supplanted by Liberators in December 1944. The first Catalina Is reached the United Kingdom early in 1941, and the first units in R.A.F. Coastal Command to operate the American flying boat were Nos. 209 and 240 Squadrons, an aircraft of the former squadron spotting the German battleship *Bismarck* on May 26, 1941, after naval forces had lost contact.

Prior to these events, in April 1939, the first production PBY-4 had been returned to Consolidated for conversion as an amphibian, a retractable nosewheel undercarriage being fitted and the aircraft re-emerging on November 22nd as the XPBY-5A. The increased utility offered by the amphibious version resulted in the modification of existing U.S. Navy PBY-5 contracts, thirty-three being completed as PBY-5A amphibians and 134 additional PBY-5As being ordered on November 25, 1940, deliveries beginning during December of the following year. Fifty examples of the amphibious PBY-5A had been ordered for the R.C.A.F., but only fourteen of these were delivered to Canada as Catalina IAs, later being renamed Canso in R.C.A.F. service. Further contracts placed during 1941-42 called for an additional 586



The PBY-5A was the first amphibious version of the Model 28. It was designated Catalina III in R.A.F. service.



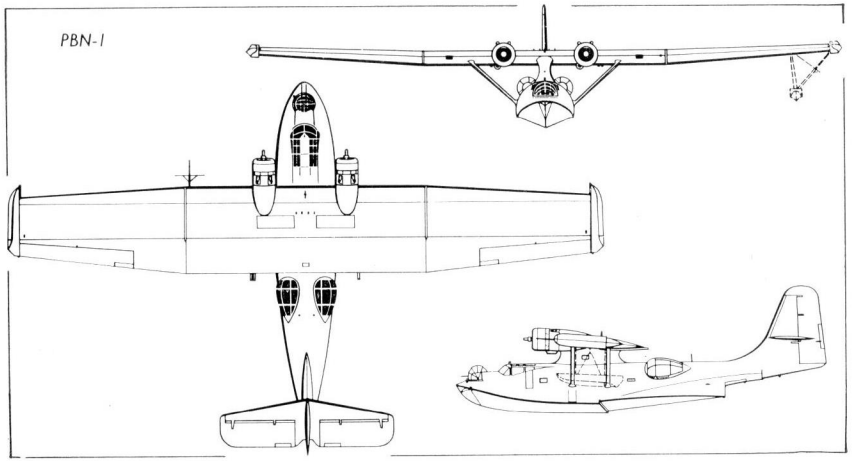


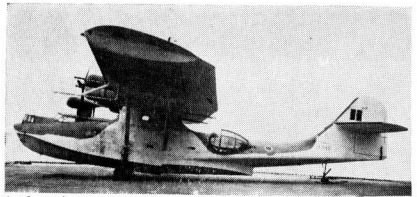
PBY-5 flying boats and 627 PBY-5A amphibians.

At this point, deliveries to the R.A.F. become somewhat confusing. The original contract for fifty Catalina Is had been doubled at an early stage, and 225 non-amphibious PBY-5B flying boats were built for the R.A.F. under Lend-Lease and entered service as Catalina IBs, but the R.A.F. also received thirty-six PBY-5s in lieu of the remaining PBY-5A amphibians on the original R.C.A.F. contract, these being dubbed Catalina IIAs. Eleven PBY-5A amphibians diverted from U.S. Navy orders became Catalina IIIs, these being the only examples of the amphibious Catalina to be received by the R.A.F., and a further ninety-seven PBY-5s with later equipment supplied to the R.A.F. under Lend-Lease became Catalina IVAs.

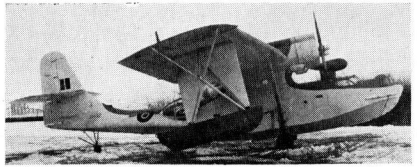
In the meantime, the Naval Aircraft Factory at Philadelphia had been making a number of modifications to the basic PBY-5 to improve both hydrodynamic and aerodynamic characteristics. It was obvious, however, that if these changes were to be incorporated on the production lines already committed to producing the PBY-5 they would seriously interfere with deliveries to the U.S. Navy. Therefore, on July 16, 1941, the Naval Aircraft Factory received an order for 156 modified aircraft under the designation PBN-1. The PBN-1, later known as the Nomad, had a sharper bow which was extended two feet; a 20° taper step amidships; the aft hull step extended some five feet further aft; a shallow breaker step added just forward of the tail; redesigned wingtip floats to improve both lift and planing characteristics; additional integral fuel tanks in the wing centre section, and redesigned, taller vertical tail surfaces. The wings were strengthened to meet a 38,000 lb. gross load, and the electrical system was modernised. The first PBN-1 Nomad was eventually delivered in February 1943, but of the 156 aircraft of this type completed, 138 were diverted to the Soviet Union under Lend-Lease, all but one of these reaching their destination where they supplemented the nationally-built GST flying boats.

A Canadian Vickers-built PBY-5A of the R.C.A.F. It was known as the Canso by that service.

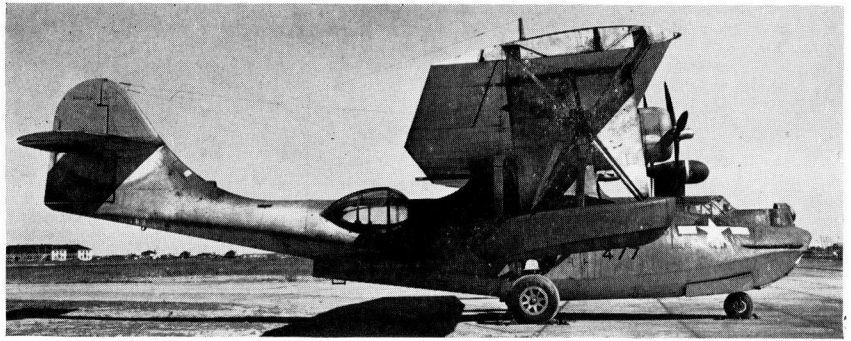




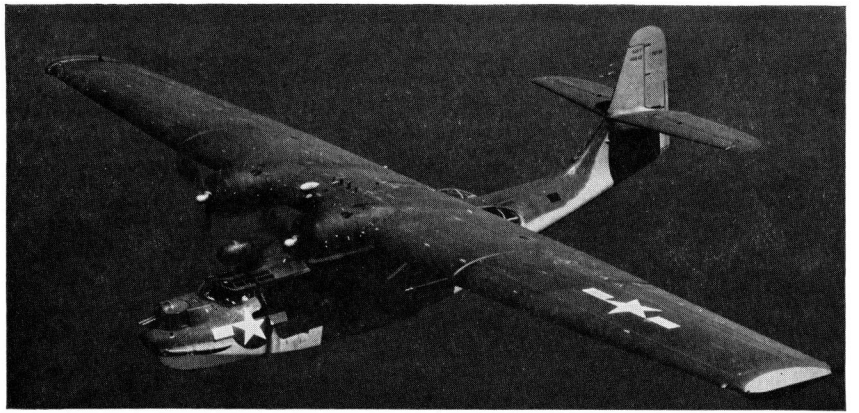
(*Above*) *A Canadian Boeing-built Catalina IVB* (*PB2B-1*) *of the R.A.F.* (*JX286*) *and* (*below*) *a Catalina VI* (*JX632*), *or PB2B-2.*



(*Below*) *An APBY-5A of the U.S. Navy. This designation was applied to machines used for administrative purposes.*



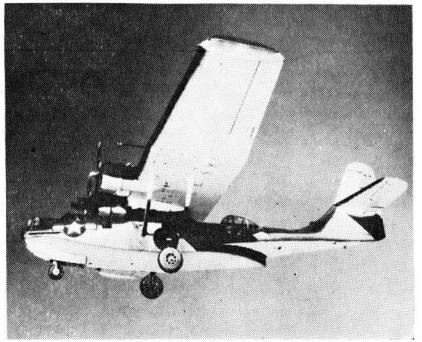
Fifty-six PBY-5As diverted to the U.S.-A.A.F. for the air-sea rescue role were designated 0A-10 by that service, and the A.A.F. also received a number of Canadian Vickers-built machines under the designation 0A-10A. Canadian Vickers Limited at Cartierville, and Boeing Aircraft of Canada at Vancouver had begun tooling for the production of the PBY-5 and PBY-5A in 1941 under an agreement between the U.S. and Canadian governments. Canadian Vickers produced their first PBY-5A amphibian on April 3, 1943. and had built 379 aircraft of this type when production terminated at Cartierville on May 19, 1945. The first production machines were delivered to the R.C.A.F. as the Canso, this service eventually receiving 149 Canadian Vickers-built aircraft, and the company began deliveries to the U.S.A.A.F. in December 1943, and to the U.S. Navy during the following May. The U.S. Navy was to have received

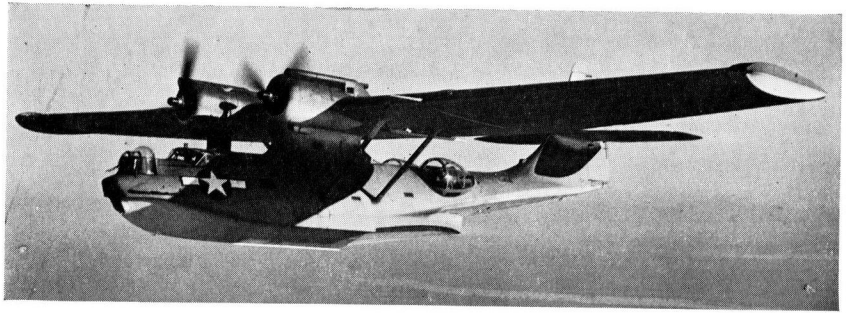


The PBY-6A was the last U.S. production version of the Catalina, 235 being built.

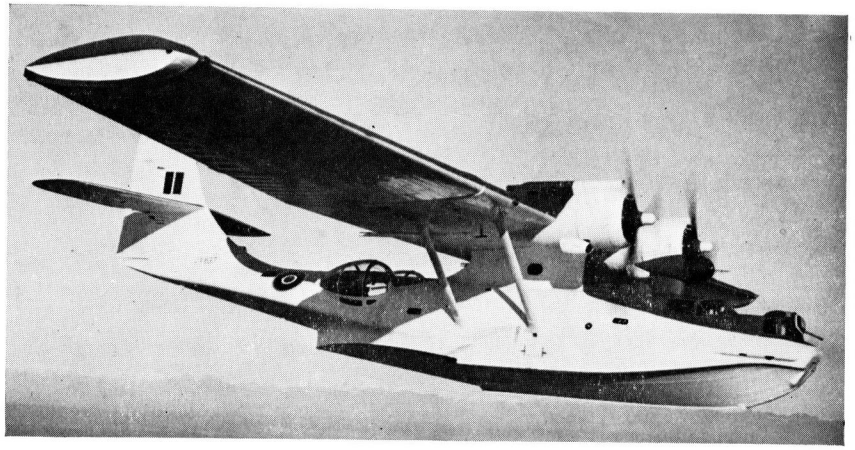
183 Canadian Vickers-built aircraft under the designation PBV-1A, but in the event, all 230 machines delivered to the U.S.A. entered service with the A.A.F. in the rescue role as 0A-10As.

Boeing Aircraft manufactured 240 non-amphibious PBY-5s under the designation PB2B-1, the first of these having flown on May 12, 1943, and these were followed by fifty PB2B-2s with the taller vertical tail surfaces introduced on the Naval Aircraft Factory's PBN-1 Nomad. The Canadian Boeing concern manufactured a further seventeen Catalinas and fifty-five Canso amphibians for the R.C.A.F. to bring production to 362 machines. One hundred and ninety-three of the PB2B-1s were supplied to the R.A.F. as the Catalina IVB, the remainder serving with





(Above) A PB2B-2 of the U.S. Navy and (below) the similar Catalina VI of the R.A.F.

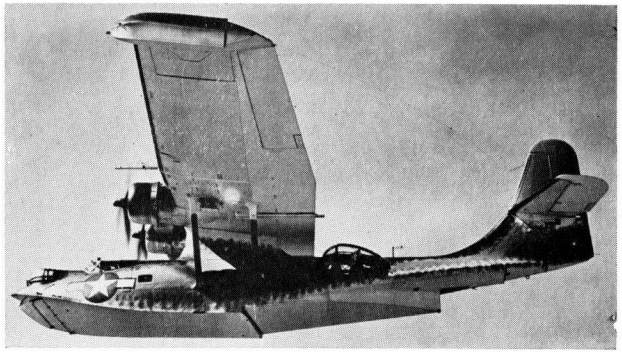


the R.A.A.F. and the R.N.Z.A.F., and PB2B-2s delivered to the R.A.F. were designated Catalina VI, the designation Catalina V having been reserved for the PBN-1.

The changes introduced by the PBN-1 were finally incorporated in the last U.S. production version of the Catalina, the PBY-6A amphibian, 235 examples of which were built between April 1944 and April 1945 at Consolidated's New Orleans plant. Forty-eight of these were delivered to the Soviet Union, and seventy-five went to the A.A.F. as 0A-10B rescue aircraft. These brought total wartime production of the Model 28 Catalina by the parent company to 2,182 machines, prewar production bringing this figure to 2,398 flying boats. No production figures are available for the Russian GST version of the Catalina, but apart from these, 892 machines were built by the Naval Aircraft Factory and the Canadian companies to bring total production to 3,290 Catalinas of all types.

Russian-built GST flying boats together with Lend-Lease PBY-6A amphibians remained in service with the Soviet forces until the mid 'fifties, and a substantial number of PBY-5A amphibians are currently serving with several of the world's smaller air arms.

The following specification relates to the PBY-5A.



The Naval Aircraft Factory-built PBN-1 Nomad.

Type: *Long-range Maritime Reconnaissance Amphibian Flying Boat (Crew:* 7-9). **Power Plants:** *Two* 1,200 *h.p. Pratt and Whitney R-*1830-92 *Twin Wasp fourteen-cylinder radial air-cooled engines.* **Armament:** *Two* 0.3-*in. machine guns in bow, one* 0.3-*in. gun in ventral tunnel and one* 0.5-*in. gun in each beam blister, plus four* 1,000-*lb. or* 500-*lb. or twelve* 100-*lb. bombs, four* 650-*lb. or* 325-*lb. depth bombs, or two MK* 13-2 *torpedoes.* **Performance:** *Maximum speed,* 169 *m.p.h. at sea level,* 179 *m.p.h. at* 7,000 *ft.; economical cruising speed,* 117 *m.p h.; time to* 10,000 *ft.,* 19.3 *min.; service ceiling,* 14,700 *ft.; maximum range,* 2,545 *mls. at* 117 *m.p.h.* **Weights:** *Empty,* 20,910 *lb.; normal loaded,* 32,415 *lb.; maximum,* 35,420 *lb.* **Dimensions:** *Span,* 104 *ft.* 0 *in.; length,* 63 *ft.* 10½ *in.; height,* 20 *ft.* 2 *in.; wing area,* 1,400 *sq. ft.*

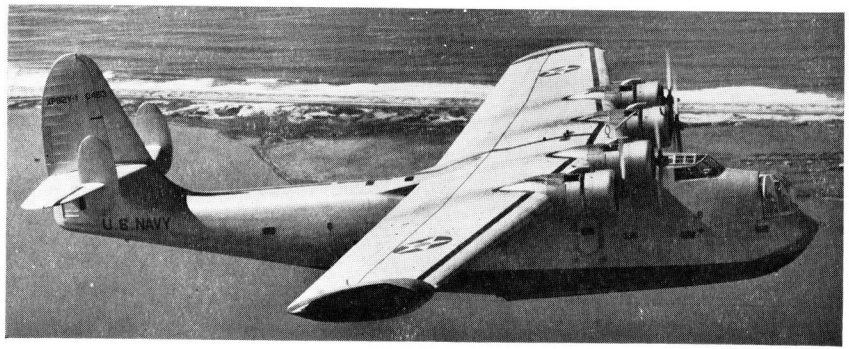
CONSOLIDATED PB2Y-2—PB2Y-5 CORONADO U.S.A.

During the mid-'thirties, the U.S. Navy began to evince an interest in the potentialities of large, four-engined maritime reconnaissance bomber flying boats, and on July 27, 1936, the Consolidated Aircraft Corporation was awarded a contract for the design and construction of such a seaplane. Designated Model 29 by its manufacturer and XPB2Y-1 by the U.S. Navy, the flying boat was of all-metal construction and featured retractable wingtip stabilising floats, internal wing bays for a bomb load of up to 12,000 lb., and a defensive armament comprising a single 0.5-in. gun in a bow turret, two 0.3-in. guns firing from waist hatches, and a 0.5-in. gun in the extreme tail.

The XPB2Y-1 flew for the first time on December 17, 1937, with four 1,050 h.p. Pratt and Whitney XR-1830-72 Twin Wasps Initial trials revealed serious lateral instability, and in an attempt to rectify this shortcoming, auxiliary vertical tail surfaces were fitted. Although some improvement resulted from this modification, it was found necessary to redesign the entire tail assembly, and the single fin-and-rudder assembly gave place to circular endplate vertical surfaces.

The XPB2Y-1 was eventually delivered to the U.S. Navy and, after completing its trials, served for some time as the Flagship of the Aircraft Scouting Force, and on March 31, 1939, six production aircraft were ordered under the designation PB2Y-2, the first of these being delivered on December 31, 1940, to U.S. Navy Squadron VP-13. The hydrodynamic qualities of the XPB2Y-1's hull had left much to be desired, and Consolidated had taken the opportunity provided by the U.S. Navy's delay in placing a production order to redesign the hull, that of the PB2Y-2 being

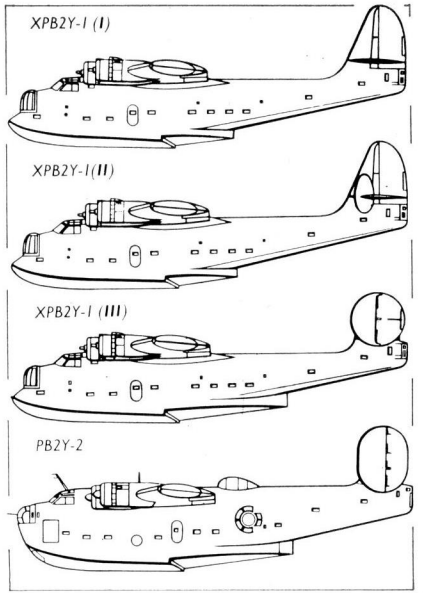
The XPB2Y-1 prototype Coronado with auxiliary vertical tail surfaces.



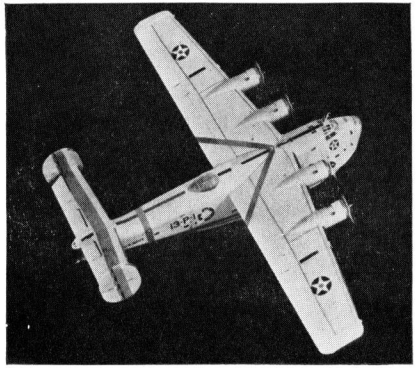
substantially deeper than that of the prototype. Vertical tail surfaces were similar to those of the B-24 Liberator bomber, and power was provided by R-1830-78 Twin Wasps rated at 1,200 h.p. for take-off. Named Coronado, the PB2Y-2 carried a crew of nine and a defensive armament of six 0.5-in. machine guns. Empty weight had risen from the 26,847 lb. of the prototype to 34,315 lb., and normal gross weight was increased from 49,754 lb to 60,441 lb. The PB2Y-2 was to be the fastest version of the Coronado built, maximum speed ranging from 224 m.p.h. at sea level to 255 m.p.h. at 19,000 ft.

The six PB2Y-2s were employed mostly for experimental purposes, lacking self-sealing fuel tanks and armour protection for the crew, and one was converted as the XPB2Y-3, the production PB2Y-3 having been ordered on November 19, 1940. The PB2Y-3 was powered by R-1830-88 Twin Wasps, the main 666 Imp. gal. fuel tanks were self-sealing, 2,000 lb. of armour protection was provided for the crew, and defensive armament was increased to twin 0.5-in. guns in the bow, dorsal and tail turrets, and a 0.5-in. gun in each beam position. Later PB2Y-3s were equipped with surface search radar installed in a housing immediately aft of the flight deck.

A total of 210 PB2Y-3 Coronados had been built when the last was delivered in October 1943, but these were progressively supplanted by the shore-based PB4Y-1 Liberator during 1944. Ten Coronados, designated PB2Y-3B, were delivered to the United Kingdom under Lend-Lease, these being intended for use by R.A.F. Coastal Command. In the event they were passed to No. 231 Squadron of R.A.F. Transport Command who flew them on freight services across the North Atlantic and between Africa and the West Indies. Thirty-one other PB2Y-3s were converted by the Rohr Aircraft



Corporation for the transport role under the designation PB2Y-3R. The conversion included the replacement of the R-1830-88 engines with their two-speed superchargers by R-1830-92 single-stage low-altitude engines rated at 1,200 h.p. at sea level, the airscrews of the inboard engines being four-bladed and those of the outboard engines being three-bladed. All military equipment was removed,

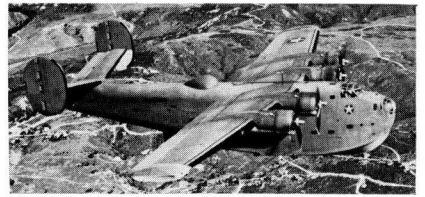


(Above and left) One of the six PB2Y-2 boats delivered to U.S. Navy Squadron VP-13

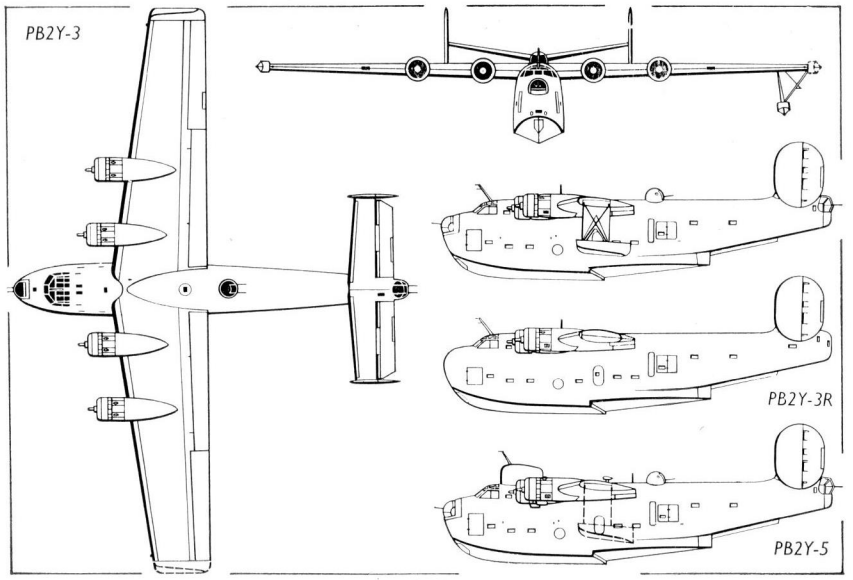
the nose and tail turret positions being faired over, the control runs were re-routed, and a special cargo floor with tie-down rings and a large cargo hatch were provided. In its unladen state the PB2Y-3R weighed 8,000 lb. less than the standard PB2Y-3, and it carried a crew of five and forty-four passengers, twenty-four passengers and an 8,600-lb. cargo load, or a 16,000-lb. cargo load.

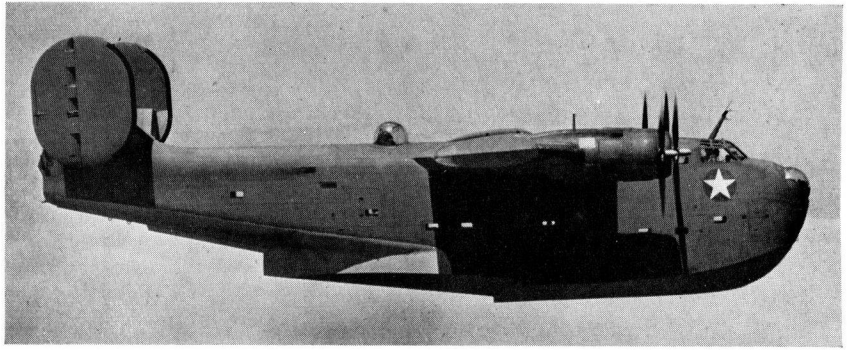
One PB2Y-3 was experimentally fitted with Wright R-2600 Cyclone engines as the XPB2Y-4, and following the successful power plant modification in the PB2Y-3R, other -3s were converted to take the low-altitude R-1830-92

engines under the designation PB2Y-5. The re-engined patrol bomber featured an increase in fuel capacity, the normal fuel load being raised from 1,580 Imp. gal. to 2,512 Imp. gal., range with an 8,000-lb. bomb load being stretched from 1,370 to 1,640 miles. Other -3 conversions of the Coronado with the low-

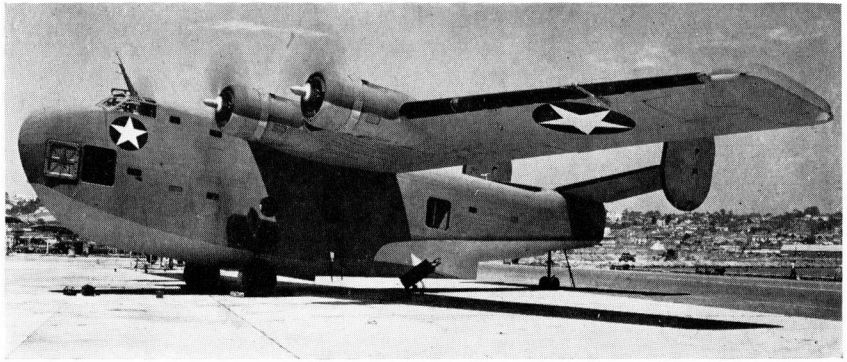


(Right) The XPB2Y-3 converted from one of the six production PB2Y-2s.





(Above) A standard PB2Y-3 Coronado and (below) one of the thirty-one PB2Y-3R transports.



altitude engines had all military equipment removed and were used as ambulance aircraft in the Pacific under the designation PB2Y-5H. This variant had accommodation for twenty-five stretcher cases, and, like other -5s, could use take-off assistance rockets.

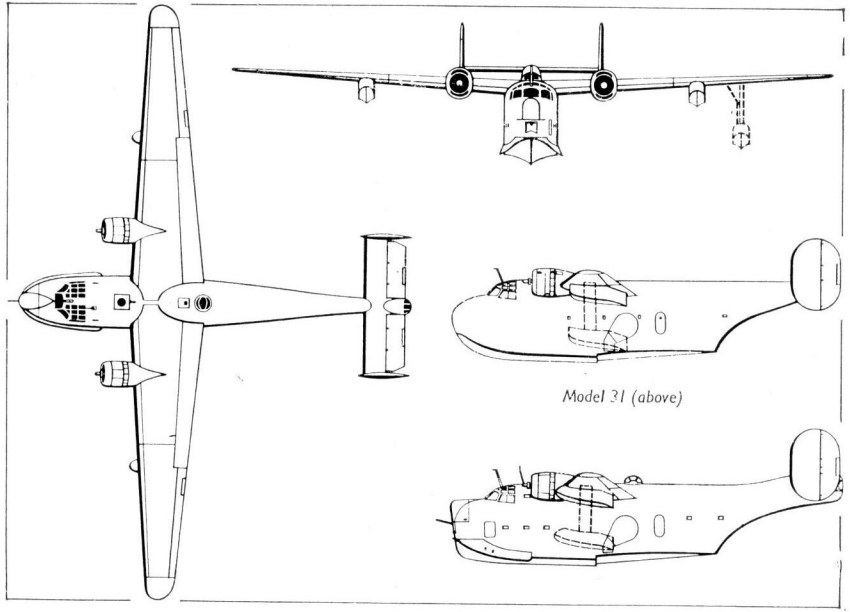
The following specification relates to the PB2Y-3 Coronado.

Type: *Long-range Maritime Reconnaissance Bomber Flying Boat (Crew:* 10). **Power Plants:** *Four* 1,200 *h.p. Pratt and Whitney R-*1830-88 *Twin Wasp fourteen-cylinder radial air-cooled engines.* **Armament:** *Twin* 0.5-*in. machine guns in bow, dorsal and tail turrets and one* 0.5-*in. gun in each of two beam positions, plus eight* 1,000-*lb.,* 500-*lb., or* 100-*lb. bombs internally and four* 1,000-*lb., four* 500-*lb. or twelve* 100-*lb. bombs, four* 650-*lb. or* 325-*lb. depth bombs or two MK* 15 *or MK* 13-2 *torpedoes externally.* **Performance:** *Maximum speed,* 199 *m.p.h. at sea level,* 223 *m.p.h. at* 20,000 *ft.; economical cruising speed,* 141 *m.p.h. at* 1,500 *ft.; initial climb rate,* 570 *ft./min.; time to* 10,000 *ft.,* 21.5 *min., to* 20,000 *ft.,* 58 *min.; service ceiling,* 20,500 *ft.; maximum range,* 2,370 *mls. at* 141 *m.p.h.; normal range (with* 8,000-*lb. internal bomb load),* 1,370 *mls.* **Weights:** *Empty,* 40,935 *lb.; loaded,* 68,000 *lb.* **Dimensions:** *Span,* 115 *ft.* 0 *in.; length,* 79 *ft.* 3 *in.; height,* 27 *ft.* 6 *in.; wing area,* 1,780 *sq. ft.*

*The PB2Y-5 was a conversion of the PB2Y-3 with low-altitude R-*1830-92 *engines.*

CONSOLIDATED XP4Y-1 U.S.A.

The XP4Y-1 shore-based patrol, torpedo-bomber and minelayer flying boat, unofficially dubbed "Corregidor", was the military version of the Consolidated Model 31. The prototype of the Model 31 was completed in May 1939, and was intended for both civil and military roles, carrying fifty-two passengers as a commercial transport. The Model 31 was an all-metal flying boat with a flush-riveted smooth skin and fabric-covered control surfaces, and the prototype was extensively modified during its prolonged period of testing, eventually emerging in April 1942 as the XP4Y-1. One of the first changes was the redesign of the rear fuselage to provide for the installation of a tail turret. The modified

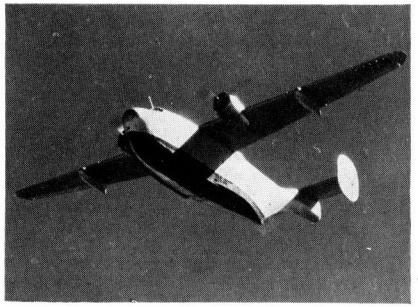


Model 31 (above)

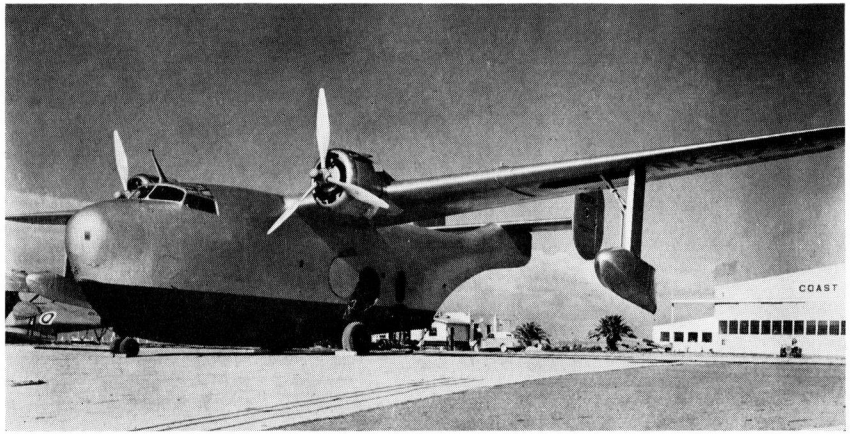
The XP4Y-1 is illustrated above in its final form with modified bow and dummy nose turret.

fuselage raised the tail assembly considerably, and, subsequently, the bow of the hull was extensively redesigned, a form of cuff being added, the retractable stabilizing floats were redesigned, and dummy gun turrets were fitted.

Proposed defensive armament comprised a 37-mm. cannon with 120 rounds in a powered nose turret, and twin 0.5-in. machine guns in nose and dorsal turrets with a total of 4,000 rounds available. Underwing attachment points were to be provided for two Mk.13-2 torpedoes, eight 325-lb. bombs or four 1,000-lb. mines.



(Right) The Model 31 in its interim form still retaining its civil registration.



Photographed in April 1941, *the Model* 31 *is seen above after modifications to the rear fuselage to provide accommodation for a tail turret.*

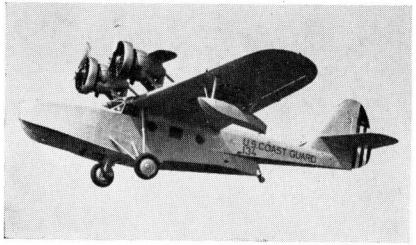
A special plant was established at New Orleans for the quantity production of the P4Y-1, but the Wright R-3350 Cyclone power plants employed by the flying boat were needed more urgently for the B-29 Superfortress and, in consequence, during the summer of 1943 production contracts for the P4Y-1 were cancelled, the New Orleans plant subsequently building the Catalina.

Type: *Long-range Maritime Reconnaissance Bomber Flying Boat.* **Power Plants:** *Two* 2,300 *h.p. Wright R-3350-8 Cyclone* 18 *eighteen-cylinder radial air-cooled engines.* **Armament:** (*Proposed*) *One* 37-*mm. cannon in bow turret and two* 0.5-*in. machine guns in each of dorsal and tail turrets, plus a* 4,000-*lb. external ordnance load.* **Performance:** *Maximum speed,* 247 *m.p.h. at* 13,600 *ft.,* 231 *m.p.h. at sea level; economical cruising speed,* 136 *m.p.h.; initial climb rate,* 1,230 *ft./min.; time to* 10,000 *ft.,* 9.8 *min., to* 20,000 *ft.,* 27.3 *min.; service ceiling,* 21,400 *ft.; range* (*eight* 325-*lb. depth charges*), 2,300 *mls. at* 2,500 *ft.,* (*two Mk.*13-2 *torpedoes*), 1,745 *mls.; maximum range,* 3,280 *mls.* **Weights:** *Empty,* 29,334 *lb.; normal loaded,* 46,000 *lb.; maximum,* 48,000 *lb.* **Dimensions:** *Span,* 110 *ft.* 0 *in.; length,* 74 *ft.* 1 *in.; height.* 25 *ft.* 2 *in.; wing area,* 1,048 *sq. ft.*

DOUGLAS DOLPHIN

U.S.A.

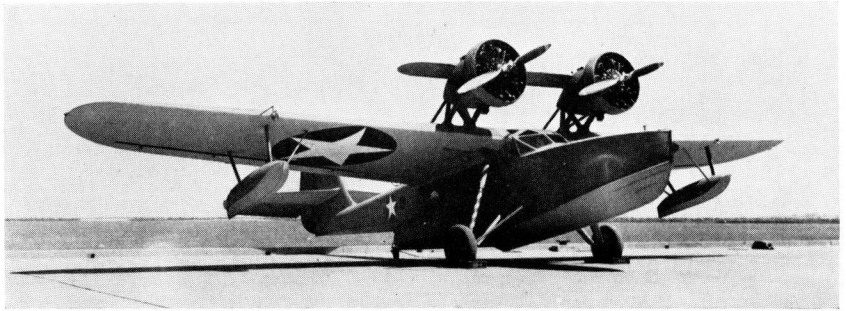
Intended primarily as an eight-seat commercial amphibian flying boat, the Dolphin was first produced in 1931, and in the following year was ordered by the U.S. Army Air Corps as a command transport under the designation Y1C-21. The Y1C-21 was a seven-seat amphibian powered by two 350 h.p. Wright R-975-3 Whirlwind radials, and featured a two-spar wooden wing with metal-framed Handley Page slotted ailerons, a metal semi-monocoque hull and an undercarriage which could be folded manually after the plane had been rolled into the water but which could not be retracted in flight. Two similar aircraft powered by 300 h.p. Pratt and Whitney R-985-1 Wasp Juniors were ordered under the designation Y1C-26, these being followed by eight Y1C-26As powered by 350 h.p. R-985-5 engines and six C-26Bs with R-985-9 engines of similar power. Two of the C-26Bs were completed with enlarged cabins for a maximum of nine seats in 1934, these being redesignated C-29s.

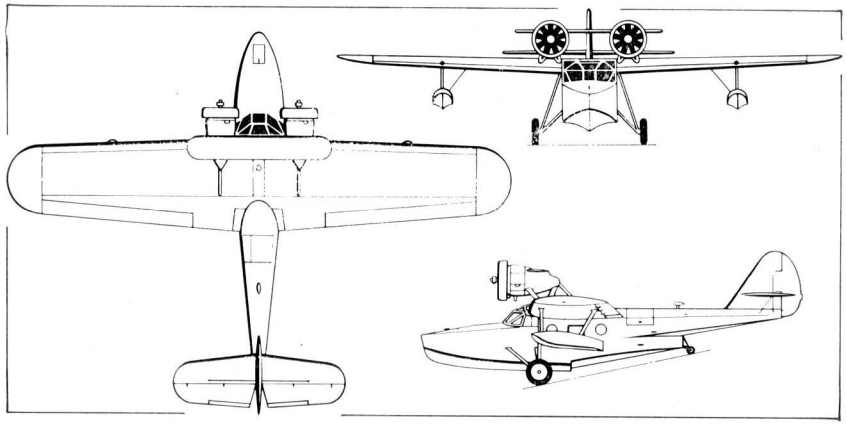


*One of the ten Dolphins supplied to the U.S. Coast Guard under the designation RD-*4.

Changes in the roles assigned to the Army Air Corps' Dolphins in 1934 resulted in their redesignation as observation amphibians with accommodation for four crew members, the Y1C-21s becoming OA-3s, the Y1C-26s becoming OA-4s, and the Y1C-26As and C-26Bs being redesignated OA-4As and OA-4Bs res-

*An RD-*4 *of the U.S. Coast Guard photographed in June* 1942 *in wartime finish.*





pectively. In 1936-37, the OA-4s, four of the OA-4As and one OA-4B were fitted with stainless-steel wings in place of the original wooden wings, all seven aircraft being designated OA-4C. One OA-4 was experimentally fitted with a fixed nose-wheel undercarriage.

A Wasp Junior-powered command version for the U.S. Navy was designated XRD-1, this being followed by three RD-2s with sturdier engine-mounting struts, and six RD-3s powered by 450 h.p. R-1340-96 Wasp engines, and one of the RD-2s and two of the RD-3s were delivered to the U.S. Marine Corps. Ten further machines for the U.S. Coast Guard were designated RD-4, and Dolphin amphibians were used in the command, utility transport and rescue roles by all services during the early war years. One Dolphin was also used in the training role by the Royal Australian Air Force. This particular aircraft was presented to the Commonwealth Government early in 1940 by the Australian Petroleum Company, having previously been used for oil survey tasks in New Guinea.

The following specification relates to the RD-4 version of the Dolphin as used by the U.S. Coast Guard.

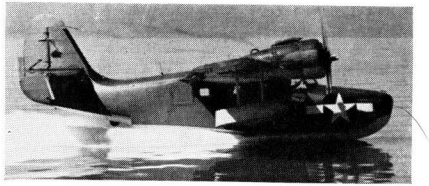
Type: *Eight-seat Utility Amphibian Flying Boat.* **Power Plants:** *Two* 450 *h.p. Pratt and Whitney R*-1340-96 *Wasp nine-cylinder radial air-cooled engines.* **Performance:** *Maximum speed,* 156 *m.p.h.; cruising speed,* 135 *m.p.h.; range,* 720 *mls.; initial climb,* 850 *ft./min.; service ceiling,* 17,000 *ft.* **Weights:** *Empty,* 7,000 *lb.; loaded,* 9,530 *lb.* **Dimensions:** *Span,* 60 *ft.* 0 *in.; length,* 45 *ft.* 1 *in.; height,* 14 *ft.* 0 *in.; wing area,* 592 *sq. ft.*

GRUMMAN G-21A (GOOSE) U.S.A.

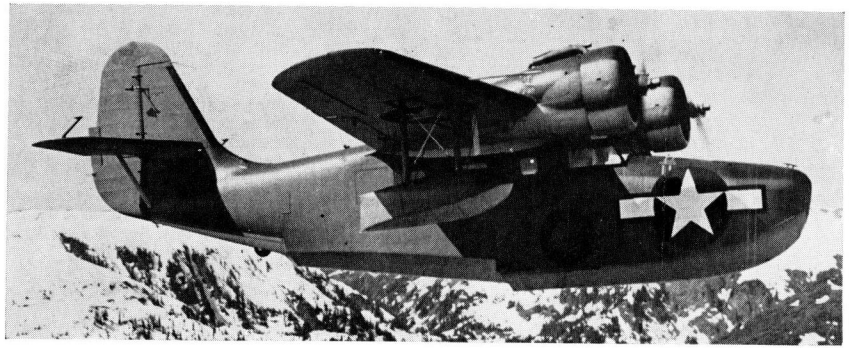
The Grumman G-21 was the first in a long line of small twin-engined amphibian flying boats, and was originally designed late in 1936 as a six-seven-seat commercial aircraft. Of all-metal construction with a two-step hull, the design of which was based on the central float of the earlier J2F-1 Duck amphibious floatplane, the G-21 was powered by two 450 h.p. Pratt and Whitney Wasp Junior engines and flew for the first time in June 1937.

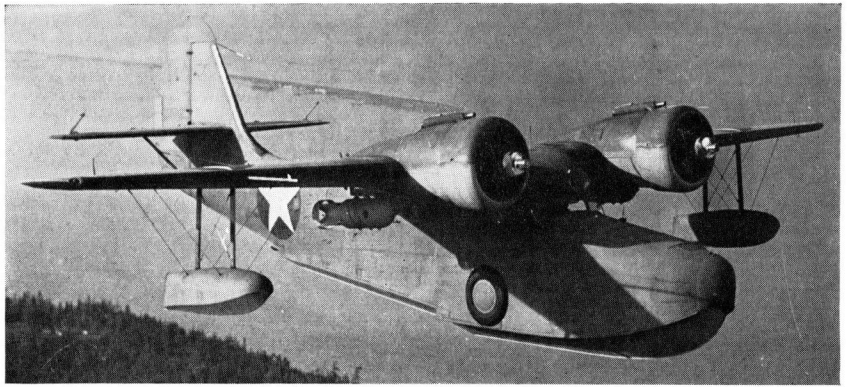
The principal commercial production model was the G-21A which differed from the original G-21 in having a 500-lb. increase in loaded weight and R-985-SB2 engines in place of the earlier R-985-SBs. The first military adaptation of the amphibian was ordered by the U.S. Army Air Corps which placed a contract for twenty-six machines in 1938, these being intended for the utility role under the designation OA-9. This order was later to be supplemented by five impressed civil machines which were also designated OA-9, three G-21As with R-985-AN1 engines which, impressed in 1942, were designated OA-13As, and two U.S. Navy JRF-5s which, equipped for the dual photographic-utility role, entered service in 1945 under the designation OA-13B.

The U.S. Navy also evinced an interest in the G-21A from an early stage, ordering one



(Above, right and below) A Grumman JRF-2 serving with the U.S. Coast Guard in Alaska.

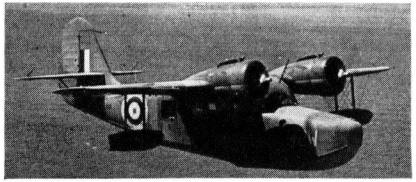




The first large-scale production model of the G-21A, the JRF-5 seen fitted with depth bomb

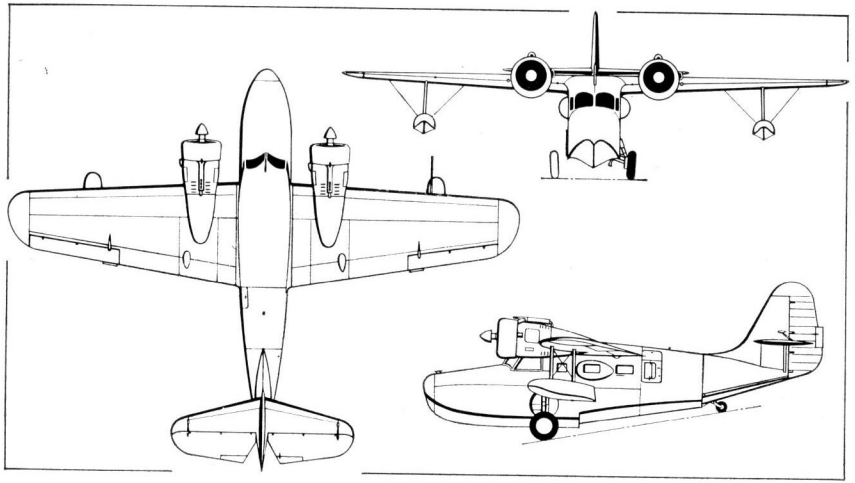
machine for evaluation in 1938 as the XJ3F-1. Ten production aircraft followed to the U.S. Navy in 1939 under the designation JRF-1. While essentially eight-seat utility transports, these aircraft could be fitted for target-towing and photography as the JRF-1A. Another ten aircraft were ordered for the U.S. Coast Guard Service, these being delivered for air-sea rescue duties in 1940. Seven of these were designated JRF-2 and the remaining three were fitted with anti-icing equipment and autopilot to suit them for rescue duties in Northern waters, these being designated JRF-3.

One of fifty JRF-6B amphibians supplied to the R.A.F. under the designation Goose IA.

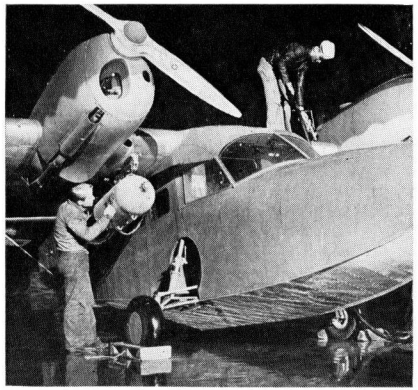


The JRF-4 was basically similar to the JRF-1 but was intended for coastal anti-submarine patrol, bomb racks for two 250-lb. bombs being fitted immediately outboard of the engine nacelles. Ten aircraft of this type were delivered to the U.S. Navy. The first large-scale production model was the JRF-5 fitted for photographic work and having R-985-AN12 engines in place of the earlier -AN6s. One hundred and ninety machines of this type were ordered, of which six were delivered to the U.S. Coast Guard for rescue duties as the JRF-5G. A half-dozen amphibians of this type were delivered to the R.A.F. as the Goose I, and a further twenty-nine were delivered to the R.C.A.F. for use among other roles as navigational trainer. The JRF-6 differed in having later electrical and radio equipment, and the JRF-6B carried navigational training equipment. Fifty aircraft of the last-mentioned version were supplied to the R.A.F. under the Lend-Lease Programme in lieu of fifty G-21As ordered in 1940 by the British Purchasing Commission and taken over by the U.S. Navy early in 1941. Designated Goose IA, these served as utility transports with No. 24 Squadron, for ferry duties with the Air Transport Auxiliary, and for air-sea rescue. Several aircraft were supplied to the Portuguese Naval Air Service.

Type: *Utility, Navigational Training and Coastal Patrol Amphibian Flying Boat.* **Power Plants:** *Two* 450 *h.p. Pratt and Whitney R-985-AN6 Wasp Junior nine-cylinder radial air-cooled engines.* **Armament:** (*Anti-submarine*) *Two* 250-*lb. bombs.* **Performance:** *Maximum speed,* 201 *m.p.h. at* 5,000 *ft.; maximum cruising speed,* 191 *m.p.h. at* 5,000 *ft.; initial climb rate,* 1,100 *ft./min.; service ceiling,* 21,000 *ft.; maximum range,* 640 *mls.* **Weights:** *Empty,* 5,425 *lb.; normal loaded,* 7,955 *lb.* **Dimensions:** *Span,* 49 *ft.* 0 *in.; length,* 38 *ft.* 4 *in.; height,* 15 *ft.* 0 *in.; wing area,* 375 *sq. ft.*



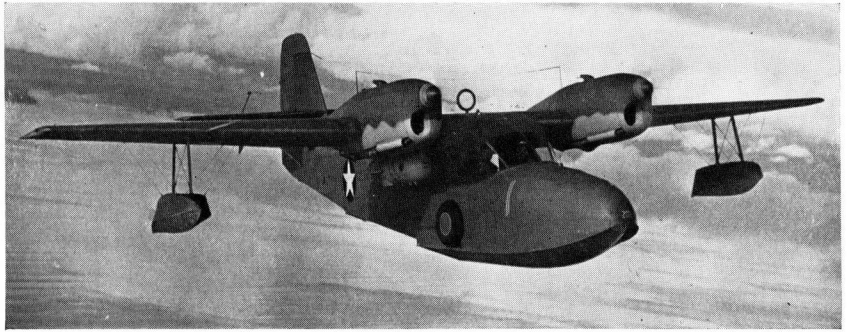
GRUMMAN G-44 (WIDGEON) U.S.A.



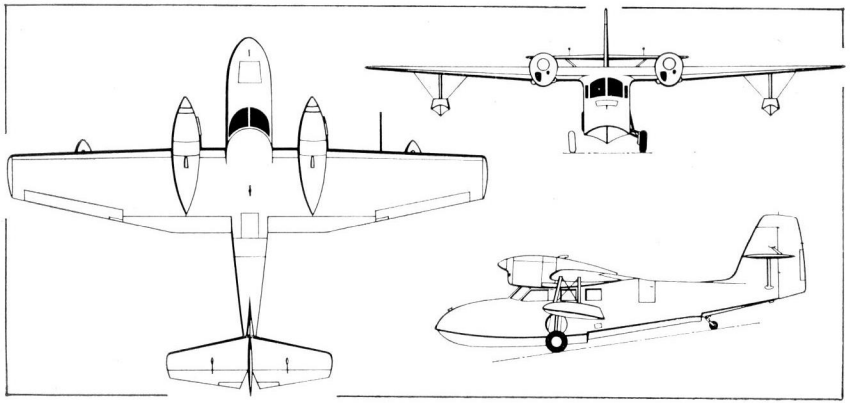
The G-44 Widgeon utility amphibian flying boat was flown for the first time in July 1940 and, like its predecessor, the G-21, was designed for commercial purposes. The first production model was, however, a three-seat anti-submarine patrol and utility model designated J4F-1 for the U.S. Coast Guard, twenty-five being delivered in 1941. However, the J4F-1 could carry only one depth bomb, this being attached to a rack under the starboard wing root, and with the crew reduced to two members, had a "negative rate of climb" on one engine, thus being unsuitable for use at any great distance from the shore. Nevertheless, in 1942 a J4F-1 of Coast Guard Squadron 212 sank the U-166 just off the Mississippi Delta in The Gulf of Mexico.

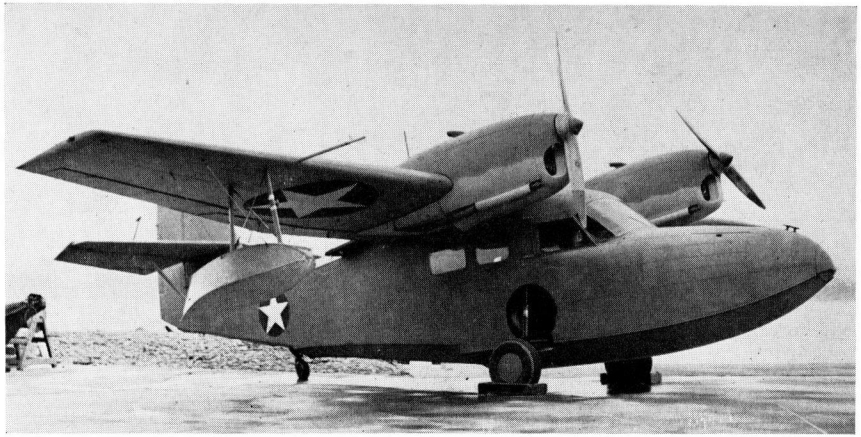
Sixteen similar aircraft were delivered to the U.S.A.A.F. in 1942 under the designation OA-14, and a further 135 were built for the U.S. Navy as J4F-2s, these being used pri-

(Above, left and below) The J4F-1 with depth bomb beneath the starboard wing root.



One of twenty-five J4F-1s supplied to the U.S. Coast Guard during 1941.





The J4F-2 served primarily as a five-seat utility transport with the U.S. Navy, 135 being ordered by that service. Fifteen of these were transferred to the Royal Navy.

marily as five-seat utility transports. Fifteen of the J4F-2s were transferred to the Royal Navy under Lease-Lend and were originally known as the Gosling I in British service. These were later renamed Widgeon I and served in the communications role, primarily in the West Indies, during 1943-45. One additional J4F-2 was allotted to the Foreign Commission in Miami, and several other aircraft of this type were delivered to the Portuguese Naval Air Service and to the Brazilian Air Force.

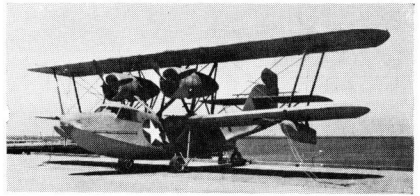
In U.S. Navy service, the J4F-2 served principally as a light personnel transport and as an instrument trainer. Like its predecessor, the G-21, the aircraft was of all-metal construction, the wing having a single box-spar housing integral fuel tanks, and the hull being divided into five water-tight compartments.

Type: *Three/five-seat Utility, Instrument Trainer and Coastal Patrol Flying Boat.* **Power Plants:** *Two* 200 *h.p. Ranger L-440-5 six-cylinder inline air-cooled engines.* **Armament:** (*Anti-submarine Patrol*) *One* 200-*lb. depth bomb.* **Performance:** *Maximum speed,* 153 *m.p.h.; cruising speed,* 138 *m.p.h.; initial climb rate,* 700 *ft./min.; service ceiling,* 14,600 *ft.; absolute ceiling,* 17,500 *ft.; maximum range,* 920 *mls.* **Weights:** *Empty,* 3,240 *lb.; loaded,* 4,525 *lb.* **Dimensions:** *Span,* 40 *ft.* 0 *in.; length,* 31 *ft.* 1 *in.; height,* 11 *ft.* 5 *in.; wing area,* 245 *sq. ft.*

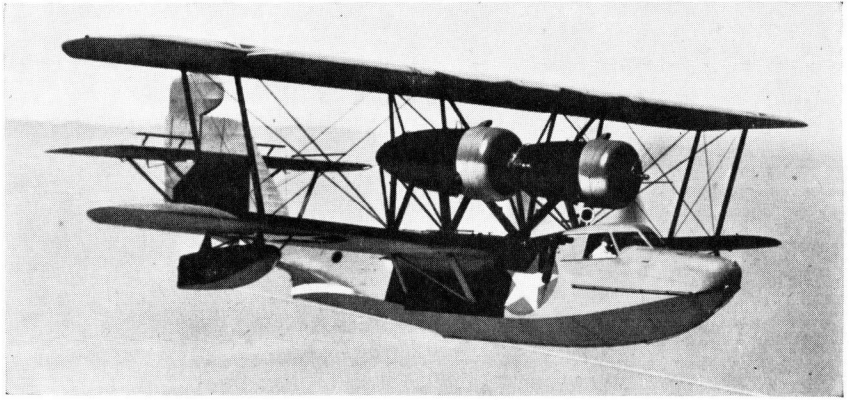
HALL PH-3 U.S.A.

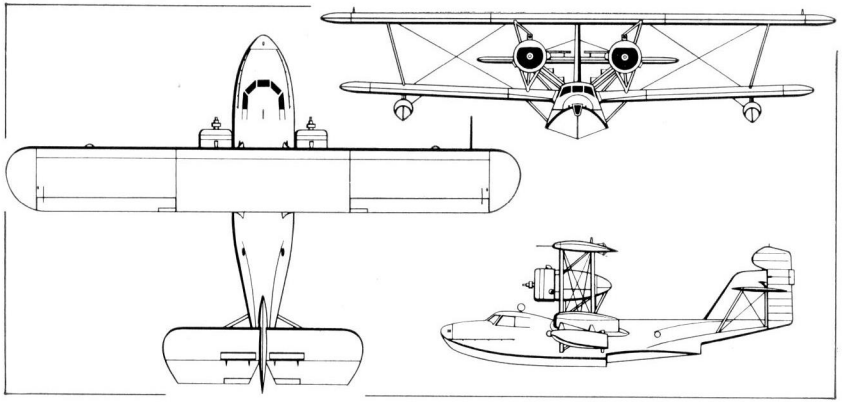
The Hall-Aluminium Aircraft Corporation began the development of an all-metal twin-engined patrol and rescue flying boat for the U.S. Navy in the late 'twenties, and the prototype, designated XPH-1, was flown for the first time in December 1929. The XPH-1 was powered by 535 h.p. Wright GR-1750 radials and had open cockpits for pilot and co-pilot and a defensive armament of twin Lewis machine guns on ring mountings in open bow and dorsal positions. Nine production aircraft were ordered on June 10, 1930, under the designation PH-1, deliveries beginning late in 1931. The PH-1 was essentially similar to the prototype apart from the installation of 620 h.p. Wright R-1820-86 radials, empty and loaded weights being increased from 6,576 to 8,251 lb. and 13,228 to 15,479 lb. respectively.

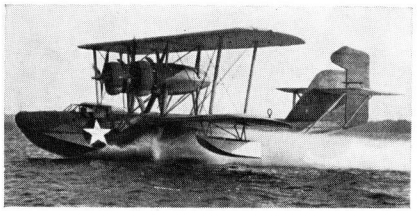
In June 1936 Hall-Aluminium received an order for five examples of a modernised, more powerful version of the basic design designated PH-2 and intended for use by the U.S. Coast



(*Above, right and below*) *Hall PH-3s of the U.S. Coast Guard at San Francisco in June* 1942.







Guard. The open bow and dorsal gun positions were deleted, the cockpit enclosed, and 875 h.p. Wright R-1820-F51 engines installed. Empty and loaded weights were increased to 9,150 lb. and 16,370 lb. respectively. An order for a further seven machines was placed for the U.S. Coast Guard two years later, these aircraft, designated PH-3, featuring a number of aerodynamic refinements such as long-chord engine cowlings and a redesigned cockpit enclosure.

Delivered in 1939, the PH-3s were armed for anti-submarine warfare and used for patrol and rescue duties with the Coast Guard during the early war years.

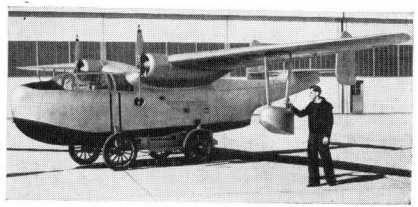
Type: *Patrol and Rescue Flying Boat* (*Crew:* 4). **Power Plants:** *Two* 875 *h.p. Wright R*-1820-*F*51 *nine-cylinder radial air-cooled engines.* **Armament:** *Four* 200-*lb. or* 250-*lb. depth bombs.* **Performance:** *Maximum speed,* 153 *m.p.h. at sea level,* 159 *m.p.h. at* 3,200 *ft.; cruising speed,* 136 *m.p.h.; service ceiling,* 21,350 *ft.; normal range,* 1,937 *mls.; maximum range,* 2,300 *mls.* **Weights:** *Empty,* 9,614 *lb.; normal loaded,* 16,152 *lb.; maximum,* 17,679 *lb.* **Dimensions:** *Span,* 72 *ft.* 10 *in.; length,* 51 *ft.* 0 *in.; height,* 19 *ft.* 10 *in.; wing area,* 1,170 *sq. ft.*

MARTIN PBM-1—PBM-5 MARINER

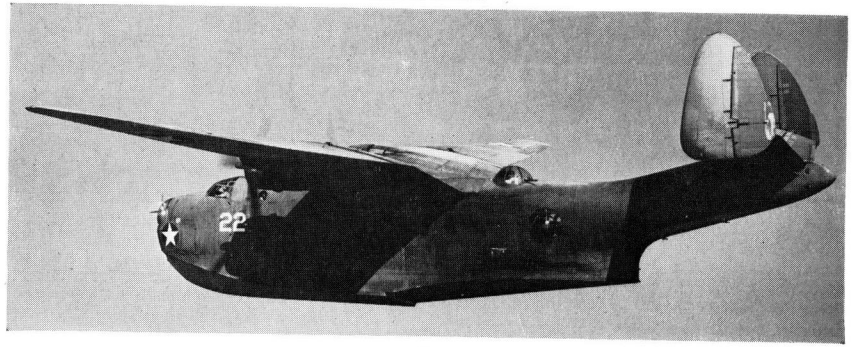
U.S.A.

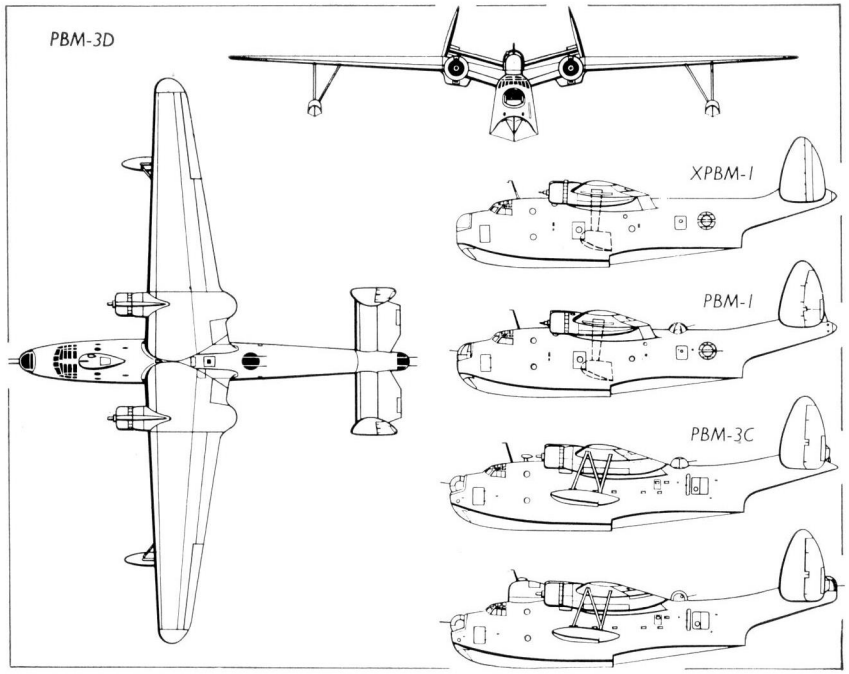
In 1937, the Glenn L. Martin Company began the design of the Model 162 medium-range maritime reconnaissance bomber flying boat, and on June 30th of that year the U.S. Navy placed an order for one prototype under the designation XPBM-1, this order being followed by another on December 28, 1937, calling for twenty production PBM-1s. The Model 162 flying boat was of advanced conception, and featured a shoulder-mounted gull wing with retractable stabilising floats, and in order to determine the hydrodynamic characteristics of the aircraft, a quarter-scale flying model, the Model 162A, was built and tested in 1937.

The XPBM-1 flew for the first time on February 18, 1939, with two Wright R-2600-6 Cyclone engines rated at 1,600 h.p. for take-off and 1,275 h.p. at 12,000 ft. Weighing 24,006 lb. empty and 40,814 lb. loaded, the XPBM-1 attained a maximum speed of 213 m.p.h. at 12,000 ft. during trials, and estimated range with a 1,000-lb. bomb load was 3,450 miles. The PBM-1 was similarly powered to the prototype, and the first aircraft of this type was delivered to VP-55 on September 1, 1940. The initial production model, to which the name Mariner was later applied, differed from



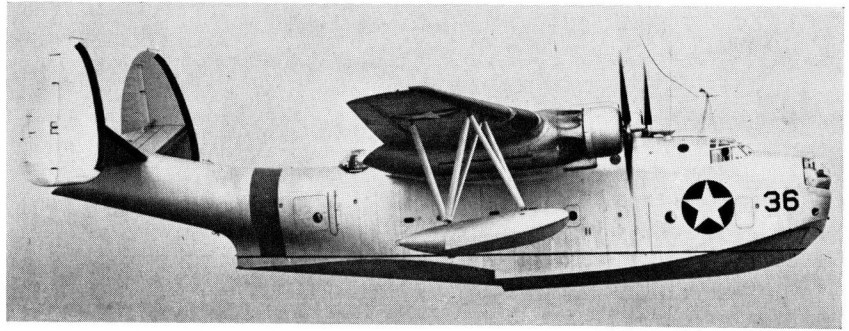
(*Below*) *One of twenty PBM-1s with retractable stabilising floats and* (*above*) *the quarter-scale Model 162A.*





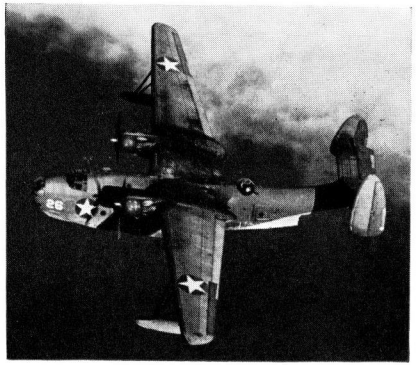
the XPBM-1 primarily in having dihedral on the horizontal tail surfaces. Seven crew members were carried and defensive armament comprised a single 0.3-in. gun in a power-operated bow turret and three 0.5-in. guns in a power-operated dorsal turret and circular waist positions. A prone position with a single 0.3-in. gun was initially provided in the extreme tail, but this was deleted at an early stage. Four 500-lb. bombs could be carried in a bay in each engine nacelle.

The XPBM-2 was to have been a long-range



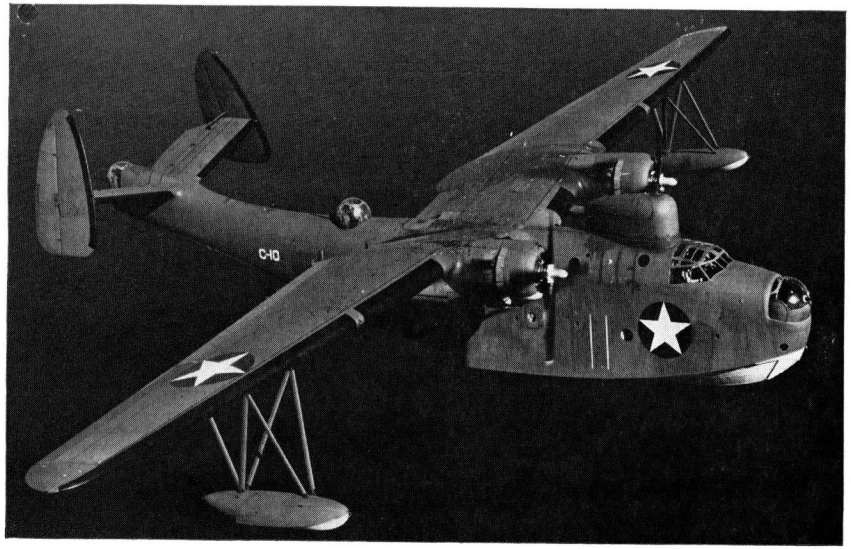
(Above) One of the first production PBM-3 Mariner patrol bombers with non-retractable stabilising floats, and (below, right) the PBM-3C which featured internal protection and revised defensive armament.

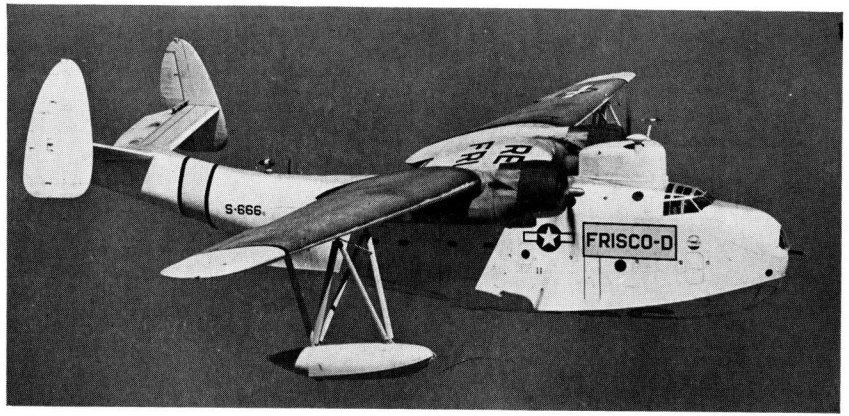
version with an increase in internal fuel capacity from 2,248 Imp. gal. to 4,010 Imp. gal., but this project was abandoned, and contracts placed between November 1, 1940 and August 20, 1941 called for 379 PBM-3s and 180 PBM-4s. In the event, however, neither version was to be delivered to the U.S. Navy in its original form. The PBM-3 differed from the PBM-1 in having enlarged, non-retractable floats, 1,700 h.p. R-2600-12 engines, lengthened engine nacelles, and revised armament, but the first fifty machines were completed as transports under the designation PBM-3R, these being delivered to the U.S. Naval Air Transport Service. The PBM-3R had all provision for armament deleted, and a strengthened cargo floor, cargo loading doors, and facilities for loading and handling cargo were introduced. Twenty passengers or a corresponding load of freight could be accommodated.



The first reconnaissance-bomber variant to be built in substantial numbers was the PBM-3C which began to appear in September 1942. Like the PBM-3R, the -3C was powered by R-2600-12 engines, internal protection was provided and defensive armament comprised twin 0.5-in. guns in a power-operated bow turret and single 0.5-in. guns in a dorsal turret, beam hatches and a tail position. Surface search radar was later installed in a large housing immediately aft of the flight deck. With the completion of 272 PBM-3C Mariners production switched to the PBM-3D, 201 examples of which were built. This model had been preceded by the PBM-3B for supply to the R.A.F. under Lend-Lease. Essentially similar to the late-production PBM-3C, the first PBM-3B reached the United Kingdom on August 18, 1943, and some twenty-five additional machines were delivered, these going to No. 524 Squadron which was formed with them at Oban on October 20, 1943.

The PBM-3D featured more powerful engines, surface search radar and many internal changes.





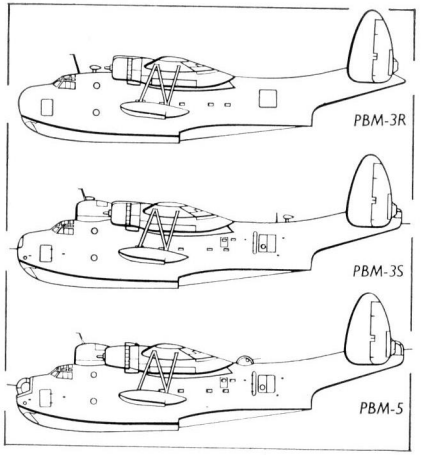
The PBM-3S which appeared in March 1944 was intended specifically for anti-submarine warfare.

However, the squadron was disbanded six weeks later, and the PBM-3B flying boats were subsequently returned to the U.S.A.

The PBM-3D was powered by 1,900 h.p. R-2600-22 Cyclones which drove four-blade airscrews in place of the original three-bladers. Apart from the 330 Imp. gal. auxiliary tanks that could be installed in the engine nacelle bomb-bays, all fuel tanks were self-sealing, armour protection for the crew members was substantially increased, and the power-operated bow, dorsal and tail turrets each housed two 0.5-in. guns, an additional 0.5-in. gun being mounted in each beam position. The engine nacelle bomb-bays could house eight 1,600-lb., 1,000-lb., or 500-lb. bombs or twelve 100-lb. bombs, alternative loads being eight 650-lb. or 325-lb. depth bombs, or four MK 13 mines. Two MK 13-2 torpedoes could be carried under the wings.

In March 1944, a further variant, intended specifically for anti-submarine warfare, the PBM-3S, made its appearance. This reverted to the R-2600-12 Cyclones, and maximum fuel capacity was increased from 2,285 Imp. gal. to 2,613 Imp. gal., boosting range with four 325-lb. depth bombs from 2,580 miles to 3,130 miles, the additional weight being compensated for by the omission of all power turrets, defensive armament comprising four hand-held 0.5-in. guns. Armour protection for the crew was reduced from 1,058 lb. to 261 lb., and a total of 156 PBM-3S Mariners was delivered.

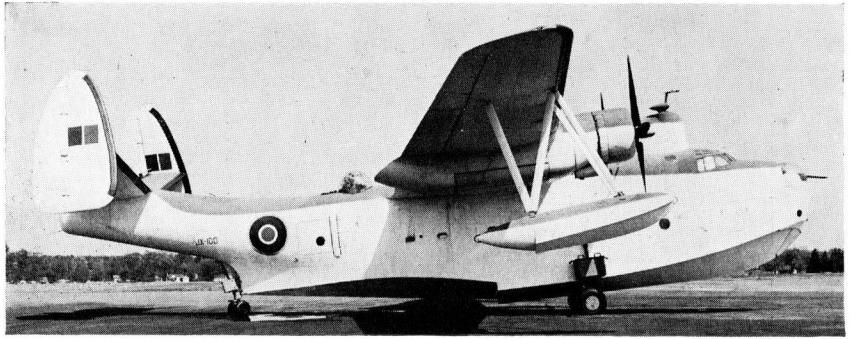
The final wartime production version of the

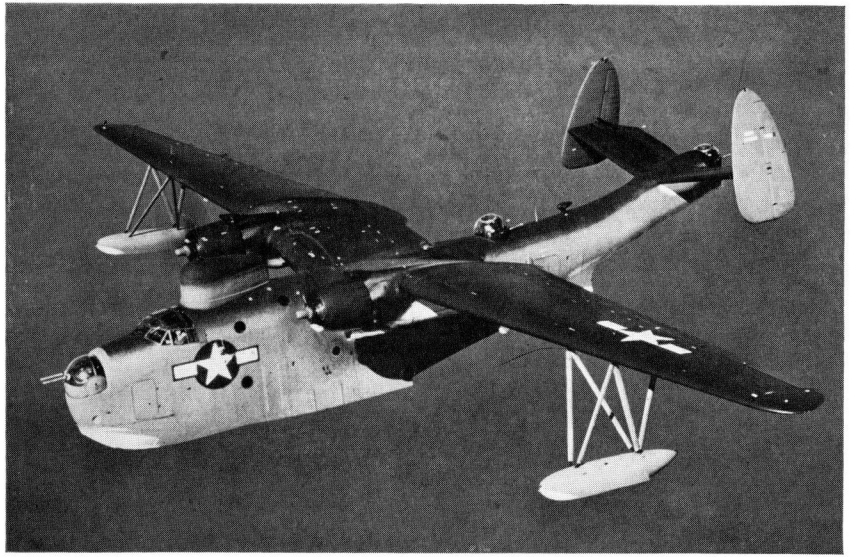


Mariner was the PBM-5 with the R-2800-34 engines rated at 2,100 h.p. for take-off. The first of two XPBM-5 prototypes had flown in May 1943, and the first production order for the PBM-5 was placed on January 3, 1944, deliveries commencing eight months later. The PBM-5 was faster than earlier Mariners, attaining maximum speeds of 198 m.p.h. at sea level and 215 m.p.h. at 19,200 ft. With a 4,000-lb. bomb load it attained a range of 2,480 miles, and defensive armament was similar to that of the PBM-3D. Four hundred and sixty PBM-5s were cancelled, but 589 were delivered to bring wartime Mariner production to 1,289 machines, and to these were later added thirty-six examples of a post-war development, the amphibious PBM-5A.

The following specification relates to the PBM-3D Mariner.

The PBM-3B Mariner I was supplied to the R.A.F in 1943, *equipping No.* 524 *Squadron for a brief period but never used operationally.*





The PBM-5 was the final wartime production version of the Mariner, and 589 *were delivered.*

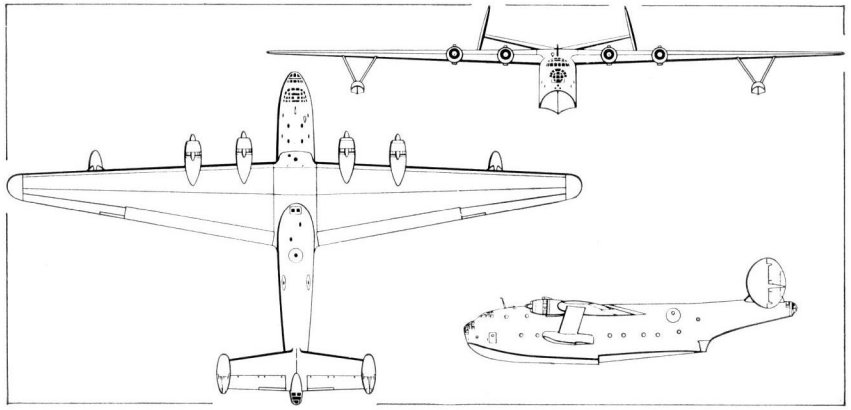
Type: *Maritime Reconnaissance Flying Boat* (*Crew:* 7-8). **Power Plants:** *Two* 1,900 *h.p. Wright R-*2600-22 *Cyclone fourteen-cylinder radial air-cooled engines.* **Armament:** *Twin* 0.5-*in. machine guns in power-operated nose, dorsal and tail turrets, and one* 0.5-*in. in each of two beam positions, plus a maximum bomb load of* 8,000 *lb.* **Performance:** *Maximum speed* (*at* 51,330 *lb.*), 196 *m.p.h. at sea level,* 211 *m.p.h. at* 16,100 *ft.; economical cruising speed,* 127 *m.p.h. at* 1,500 *ft.; time to* 10,000 *ft.,* 22.2 *min.; service ceiling,* 19,800 *ft., range,* 2,240 *mls.* **Weights:** *Empty,* 33,175 *lb.; normal loaded,* 51,330 *lb.; maximum,* 58,000 *lb.* **Dimensions:** *Span,* 118 *ft.* 0 *in.; length,* 79 *ft.* $9\frac{7}{8}$ *in.; height,* 27 *ft.* $6\frac{1}{8}$ *in.; wing area,* 1,408 *sq. ft.*

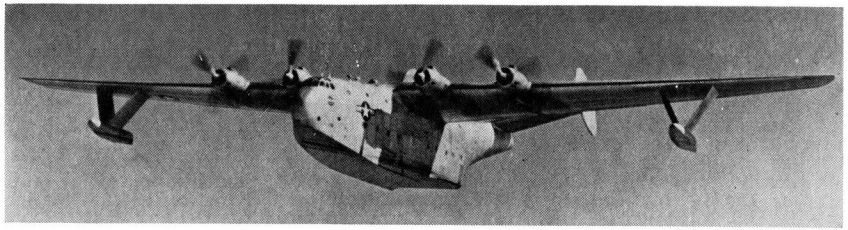
MARTIN XPB2M-1— MARS

U.S.A.

Launched for the first time on November 8, 1941, the Model 170 Mars, or XPB2M-1, was the world's largest flying boat and had been ordered on August 23, 1938, as a long-range maritime reconnaissance bomber. An accident during preliminary trials delayed the first flight until July 3, 1942, but although provision was made for power-operated gun turrets in the bow and extreme tail, the XPB2M-1 featured no internal protection, and it may be presumed that the extensive modifications that would have been necessary to bring the flying boat to combat standards and the immense production effort called for to produce the type in quantity were the reasons for the discontinuation of development of the Mars in the role for which it was designed.

During 1943 the gun turrets were faired over, the floors reinforced, larger hatches and loading equipment provided, and the Mars became the XPB2M-1R cargo transport. In December 1943 the Mars made its first flight as a naval transport, carrying a 13,000-lb. load non-stop between the Patuxent River Naval Air Station and Natal, Brazil, a distance of 4,375 miles. Early in 1944, the Mars completed a 4,700-mile round trip to Hawaii in 27 hr. 26 min., delivering a 20,500-lb. cargo load. The success of the Mars in the transport role prompted an order from the U.S. Navy for twenty examples of a modified model built from the ground up as a cargo transport and designated JRM-1. However, the first JRM-1 was not flown until after the termination of hostilities, and the U.S. Navy contract was later reduced to five aircraft.

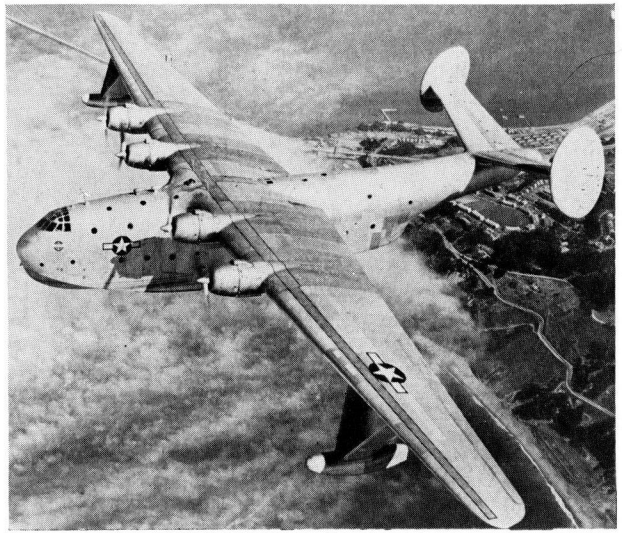




The XPB2M-1 Mars after conversion in 1943 *as the XPB*2M-1*R naval transport.*

The following specification relates to the XPB2M-1 in its original maritime reconnaissance bomber form.

Type: *Long-range Maritime Reconnaissance Bomber* (*Crew:* 11). **Power Plants:** *Four* 2,200 *h.p. Wright R-*3350-18 *Duplex Cyclone eighteen-cylinder radial air-cooled engines.* **Performance:** *Maximum speed,* 221 *m.p.h. at* 4,500 *ft.,* 205 *m.p.h. at sea level; cruising speed,* 149 *m.p.h.; initial climb rate,* 440 *ft./min.; service ceiling,* 14,600 *ft.; maximum range,* 4,945 *mls.* **Weights:** *Empty,* 75,573 *lb.; loaded,* 144,000 *lb.* **Dimensions:** *Span,* 200 *ft.* 0 *in.; length,* 117 *ft.* 3 *in.; height,* 38 *ft.* 5 *in.; wing area,* 3,683 *sq. ft.*

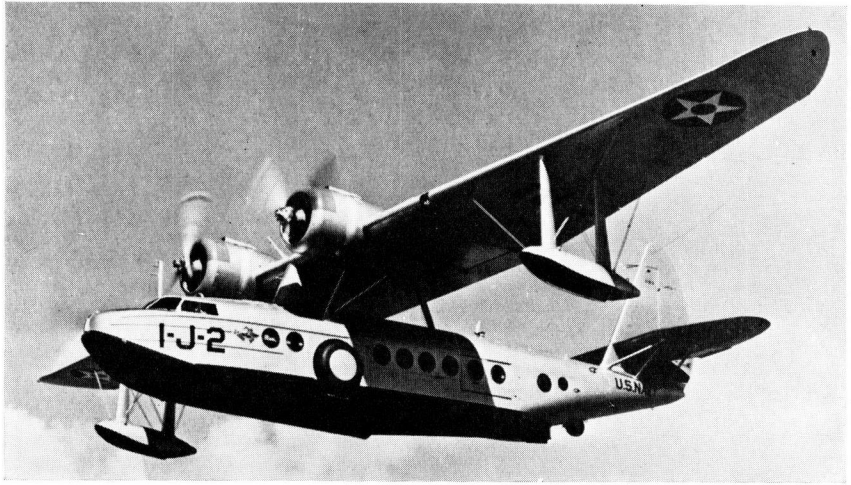


SIKORSKY JRS-1 (Y10A-8) U.S.A.

In 1935 the Sikorsky Aircraft Division of the United Aircraft Corporation produced a twin-engined commercial amphibian flying boat with accommodation for fifteen passengers. Designated S-43, it followed the basic configuration of earlier Sikorsky flying boats, and was of all-metal construction with a hydraulically retractable tailwheel undercarriage. The S-43 was selected in 1937 by both the U.S. Navy and the U.S. Army Air Corps as a utility transport amphibian, the former service ordering seven machines under the designation JRS-1, and the latter ordering five as the Y1OA-8. Apart from equipment, the two models were similar, both being powered by the 750 h.p. Hornet nine-cylinder radial, the JRS-1 having R-1690-52s and the Y1OA-8 having R-1690-23s. Five of the JRS-1s entered service with the U.S. Navy's Utility Squadron VJ-1, and the remaining two machines were delivered to the U.S. Marine Corps, serving with VMJ-1 and VMJ-2.

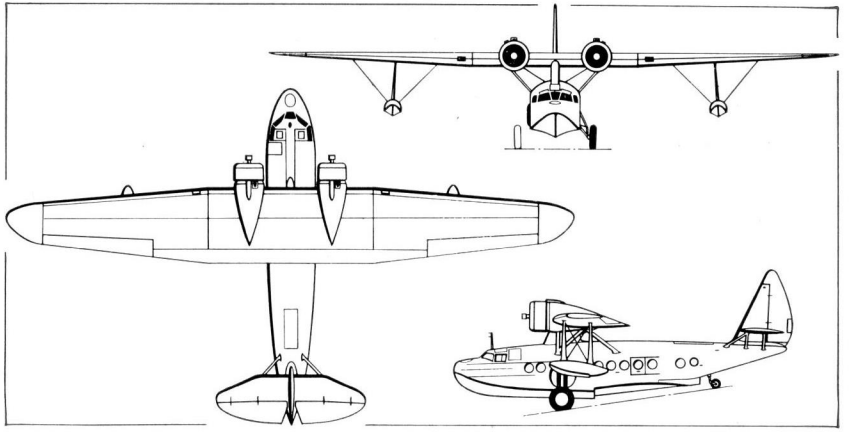
Forty-eight S-43 amphibians were ordered for use in the East Indies as reconnaissance-bombers and utility transports by the Netherlands Naval Air Service, but deliveries had not begun when the Japanese launched their attack on the East Indies in March 1942, and the order was subsequently cancelled. One commercial S-43 powered by 875 h.p. R-1690-S2C engines was impressed by the A.A.F. in 1942 as the OA-11. Both U.S. Navy and A.A.F. versions of the S-43 served in the utility transport role throughout the war years, and the following specification relates to the JRS-1.

The JRS-1 (below) was the U.S. Navy version of the commercial S-43 transport amphibian.



The U.S. Navy purchased seven JRS-1 amphibians, five of these serving with the U.S. Navy's Utility Squadron VJ-1 and two with the Marine Corps.

Type: *Fifteen-seat Utility Amphibian Flying Boat.* **Power Plants:** *Two* 750 *h.p. Pratt and Whitney R-*1690-52 *Hornet nine-cylinder radial air-cooled engines.* **Performance:** *Maximum speed,* 182 *m.p.h. at sea level,* 190 *m.p.h. at* 7,000 *ft.; cruising speed,* 160 *m.p.h. at* 1,000 *ft.,* 175 *m.p.h. at* 8,000 *ft.; initial climb rate,* 1,050 *ft./min.; time to* 10,000 *ft.,* 13 *min.; service ceiling,* 20,700 *ft.* **Weights:** *Empty,* 12,750 *lb.; loaded,* 19,096 *lb.* **Dimensions:** *Span,* 86 *ft.* 0 *in.; length,* 51 *ft.* 2 *in.; height,* 17 *ft.* 8 *in.; wing area,* 780.6 *sq. ft.*



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